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# THE HOLY INCENSE

A BOTANICAL, PHARMACOLOGICAL  
PSYCHOLOGICAL AND ARCHAEOLOGICAL  
APPRECIATION OF THE BIBLE



DAVID I. MACHT



To Prof. Simon Gleason

with kindest regards

from

D. Maudsley.



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APPRECIATION OF THE BIBLE

BY

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*To Sarah*  
*My wife, friend, companion*  
*and source of inspiration*








"GIVE ME NOW WISDOM AND KNOWLEDGE"

—II Chron. I, 10



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# THE HOLY INCENSE

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## INTRODUCTION

Incense has played an important rôle in the ritual of all ancient cults and in none a more important one than in the Bible. It is, therefore, surprising that so little comparatively is known concerning the ingredients of biblical incense and its properties. This is probably due to the fact that most biblical scholars are not specialists in the particular fields of science under which various spices and incense logically fall. In the present work it is the purpose of the author to contribute whatever historical and archaeological data are available on the subject of biblical incense and to dwell particularly on the botanical, pharmacognostic, chemical and pharmacological characteristics of its various ingredients and also to report certain original experimental observations concerning the physiological properties of the same which have been obtained by him.

## GENERAL STATEMENT

It is well known that incense played an integral rôle in the services of the Holy Tabernacle and in the

ritual services of the Temple. The specific injunctions concerning the composition and preparation of holy incense we find in the book of Exodus, Chapter 30, verses 34 ff. where we read, And the Lord said unto Moses: "Take unto thee sweet spices, stacte, and onycha, and galbanum; sweet spices with pure frankincense; of each shall there be a like weight. And thou shalt make of it incense, a perfume after the art of the perfumer, seasoned with salt, pure and holy. And thou shalt beat some of it very small, and put of it before the testimony in the tent of meeting, where I will meet with thee; it shall be unto you most holy. And the incense which thou shalt make, according to the composition thereof ye shall not make for yourselves; it shall be unto thee holy for the Lord. Whosoever shall make like unto that, to smell thereof, he shall be cut off from his people."

As is the case with all the ordinances found in the Bible the instructions are very brief and must be interpreted in the light of tradition. We, therefore, find more explicit descriptions concerning the incense in the Talmud in the tractate Kerithoth 78. The ancients indeed call attention to the very words of the Bible in Exodus 30 as indicating according to the traditional hermeneutical rules that the ingredients of incense mentioned in the Bible are of a general character to be amplified by the oral law. The reading "sweet spices" followed by stacte, onycha and gal-

banum and then again followed by the words "sweet spices" with pure frankincense is a good example of the well known rule: "*Kelal u-perat u-Kelal.*" (See S. R. Hirsch, Commentary on Exodus 30.) We are thus told that stacte, onycha and galbanum are merely examples of the kind of ingredients to be classed as sweet spices. Each of these three must be mentioned because of the peculiarity in its properties not found in the other two. Stacte is of vegetable origin. Onycha is of mineral origin. Galbanum is also of vegetable origin but is quite different from stacte on account of its pungent and disagreeable odor. These three constituents are all of them characterized by two distinct properties. Firstly, they produce, on burning heavy fumes or vapors. Secondly, they give off on burning a powerful and penetrating aroma. Frankincense is added as an additional constituent because it differs from the above three in that while it is very fragrant, its fumes are not so heavy and visible as those of the others.

Complete instructions and specifications concerning the ingredients of the ritual incense as it was used in the Tabernacle and Temple are described as stated above in the tractate of Kerithoth.

## תלמוד מסכת כריתות ו'

פשוט הקטורת הצרי והצפרן והחלבנה והלבונה • משקל  
 שבעים שבעים מנה : מר וקציעה שבלת נדח וכרפס • משקל  
 ששה עשר ששה עשר מנה • הקשט שנים עשר • וקלופה  
 שלשה • וקמון תשעה • ברית פרשינה תשעה קבין • יין  
 קפריסין סאין תלתא וקבין תלתא • ואם אין לו יין קפריסין  
 מביא חמר תירון עתיק : מלח סדומית רבע הקב • מעלה  
 עשן כל שחוא : רבי נתן אומר אף כפת הירדן כל שחוא ואם  
 קהן בזה דבש פסלה • אם חסר אחת מכל סמניה חייב מיתה :  
 רבן שמעון בן גמליאל אומר • הצרי אינו אלא שרף הנוסף  
 מעצי הקטף : ברית פרשינה תשפין בזה את הצפרן • כדי  
 שתהא נאה : יין קפריסין תשורין בו את הצפרן • כדי  
 שתהא עזה : וחלא מי רגלים ופין לה אלא שאין מכניסין מי  
 רגלים בעזרה מפני הקבור :

Here we read: "The compound for the incense-  
 ming consisted of balm, onycha, galbanum and frankin-  
 cense, in quantities weighing seventy manehs each;  
 of myrrh, cassia, spikenard and saffron, each sixteen  
 manehs by weight; of costus twelve, of aromatic  
 bark three, and of cinnamon nine manehs; of lye or  
 alkali obtained from Karshina, nine kabs; of Cyprus  
 wine three seahs and three kabs; though, if Cyprus  
 wine was not procurable, old white wine might be  
 used; of salt of Sodom the fourth part of a kab, and

of the herb Maaleh Ashan a minute quantity. R. Nathan says a minute quantity was also required of the odoriferous herb Kippath ha-Jarden that grew on the banks of the Jordan; if, however, one added honey to the mixture, he rendered the incense unfit for sacred use, while he who, in preparing it, omitted one of its necessary ingredients, was liable to the penalty of death. Rabban Simeon, son of Gamaliel, says the balm is a resin that exudes from the wood of the balsam tree." Details concerning the various constituents will be discussed fully in the following pages. In this place a brief summary is merely given to serve as a framework for the discussion of the various constituents. It will be noted that there are altogether thirteen ingredients. The mortar in which the various spices were mixed together and ground "according to the apothecary's art," was of gold and after the destruction of the temple was brought by Titus as booty to Rome, (Yomah I. 5). The preparation of the holy incense was a difficult art and was mastered at the time of the Second Temple by a family of priests by the name of Cutinos (Josephus, V. 5). Cyprian wine used in the preparation of Onycha was undoubtedly intended as an extractive very much as alcohol is used nowadays for the preparation of fluid extracts and tinctures. The small doses of the odoriferous herb Cippah that grew on the banks of the Jordan was intended particularly to produce a power-



ful and heavy smoke characterized by the property of rising perpendicularly in the air. Further data concerning the various ingredients will be given below.

#### THE FOUR PRINCIPAL BIBLICAL INGREDIENTS

##### *Nataf or Zori*

This ingredient sometimes called Nataf and sometimes Zori and translated in some versions as *balsam*, in others as *stacte* is known to botanists as *Opobalsamum*. The word Nataf in Hebrew of course means "an exudate" and refers to the gum or resin yielded by a certain tree. According to some this gum or resin is identified with storax but the majority of botanical authorities regard Nataf as identical with balm of Gilead.

Balm of Gilead is derived from the tree *Commiphora* or *Balsamodendron Opobalsamum*, which belongs to the Burseraceae or Frankincense family and is also closely related to the *Commiphora Myrrha* or the myrrh tree. The *Opobalsamum* resin or gum is also known as *balsamum Gileadense* or Mecca gum or Indian bdellium. It is a very fragrant resinous substance, dark red in color turning to a more yellowish color as it solidifies. It used to be official in the English pharmacopeia. Thus for instance we find it mentioned in the London pharmacopeia of 1746,





FIG. 1. COMMIPHORA OPOBALSAMUM (L.) ENGL.

A, bush; B, blooming branch; C, ♂ flower; D, twig with flower; E, longitudinal section of same; F, horizontal section of flower. (After Dr. Schweinfurth.)

which authorizes the use of nutmeg oil in place of it in the preparation of Theriac. The accompanying figure gives a view of the whole plant also of its branches, leaves and flowers. (See also Fluckiger and Hanbury *Pharmacographia*, London 1879.)

Stacte is a substance often mentioned by the ancients and is the translation sometimes given of the word Nataf or Zori. Stacte however, is quite a different substance and is said by Pliny to be a spontaneous exudate obtained from the Myrrh tree. It is the "Liquid Myrrh" of the ancients.

Canada Balsam on account of its flavor is sometimes called Balm of Gilead but this is erroneous, as true balm of Gilead is not derived from the *Terebinthina Canadensis* belonging to the family of *Coniferae* but is a product of the Genus *Balsamodendron* growing in Asia Minor. The true *Opobalsamum* or Balm of Gilead is a chemically very complex substance. It contains 10 to 30 per cent of a volatile oil or oils, various resins, gums, sugar, etc.

### *Galbanum*

In contrast to Balm of Gilead and frankincense, gum galbanum does not yield a very agreeable odor. Indeed, according to the Hebrew sages this ingredient was added to incense to indicate that in any conglomerate or collective endeavor both pleasant and disagreeable ingredients or constituents are inevitable.

(Kerithoth 96.) (See also Sirach XXIV. 18.) This gum is obtained from a plant belonging to the family of Umbelliferae of which there are at least two species, (1) *Ferula Galbaniflua*, (2) *Ferula Rubricaulis*. The first is the more important one.

*Ferula Galbaniflua* is a plant with a double solid stem 4 to 5 feet high, with grayish tomentose leaves and thin flat fruits. It grows in Asia Minor and Persia. The natives used to collect the gum resin of this plant which is known as Galbanum by scraping off the tears or drops which exude spontaneously from the stem especially on its lower part and about the bases of the leaves. These tears or drops are when fresh milk-white in color but turn yellow on exposure to light and air. Galbanum comes on the market in lumps or irregular masses which consist of these tears or drops adhering to each other. The drug was used not only by the Israelites but also by other ancient peoples. Dioscorides states it to be the juice of a *Narthex* growing in Syria and describes its character and the method of purifying it by hot water, which is exactly the method followed in modern times. We find it mentioned in the second century among the drugs on which duty was levied by the Roman customs at Alexandria. (Vincent: Commerce of the Ancients. 1807 II, 692.) Under the name of Kinnah it was well known by the Arabs and through them to the physicians of Salerno. Henry III of France in an edict





FIG. 2. FERULA GALBANUM  
Showing branch and flowers of various species



made in 1581 gives the price per pound of the gum resin of the Umbelliferae as follows. Opoponax, 32 sols, Sagapenum, 22 sols, Asafoetida, 15 Sols, Galbanum, 10 sols, Ammoniacum, 6 sols, 6 deniers. (Fontanon, Edicts et Ordonnances des Rois de France 1858, II 388.)

Gum Galbanum has a peculiar characteristic and disagreeable odor and an unpleasant bitter alliaceous taste. Chemically it contains volatile oil, resin and mucilage. The oil, of which about 7 per cent may be obtained by distillation with water, is a colorless liquid containing especially the hydrocarbon  $C_{10}H_{16}$  boiling at  $170^{\circ}$  to  $180^{\circ}$ . This oil contains also other hydrocarbons of a much higher boiling point. The oil turns the plane of polarized light to the right. The resin constitutes about 60 per cent of Galbanum. It is very soft and dissolves in ether and alkalies. When heated for some time at  $100^{\circ}$  Centigrade with hydrochloric acid it yields *umbelliferone*, which is a compound soluble in hot water, and a solution of which in alkali exhibits a brilliant blue fluorescence. By submitting Galbanum-resin to dry distillation there is obtained thick oil of intense and brilliant blue color which is characteristic of Galbanum. By fusing Galbanum-resin with potash resorcin can be obtained. When Galbanum-resin is heated with concentrated hydrochloric acid a red color is developed which turns violet on the addition of alcohol. Galbanum is still

described in various dispensatories of modern nations and therapeutically it has been recommended as a stimulating expectorate. Virgil recommended the fumes of Galbanum for driving away snakes. Figure 2 gives an excellent picture of the plant with its flowers.

In imitation of the ancient Jewish custom, Galbanum is a component, of the incense used in the Irvingate Chapels in London.

### *Frankincense or Olibanum*

This ingredient of biblical incense is perhaps the one concerning which there is the least difference of opinion. Practically all writers on the subject state that frankincense or olibanum is obtained from the stem of several species of *Boswellia* inhabiting the hot and arid regions of Africa, Southern Coasts of Arabia and neighboring regions. The most important variety is *Boswellia Carterii* of which an illustration is here presented. (Jour. of Bombay Branch of Royal Asiatic Soc. II, 1898, pp. 3801.) Olibanum is sometimes called in Latin *Thus Masculum*, in French it is *Encens* and in German it is *Weihrauch*. The *Libanos* of the Greeks, the Latin *Olibanum* as well as the Arabic *Lubân* and the analogous words in other languages are all derived from the Hebrew *Lebonah* signifying white and referring to the milky appearance of the fresh juice as it exudes from the tree.





FIG. 3. *BOSWELLIA CARTERI* OR FRANKINCENSE  
(After Birdwood)

The use of Olibanum goes back to a period of extreme antiquity, as proved by the numerous references in the writings of the Bible and other ancient documents to incense, of which it was an essential ingredient. It is moreover well known that many centuries before Christ the drug was one of the most important objects of the traffic which the Phoenicians and Egyptians carried on with Arabia. (See Movers: *Das Phönizische Alterthum*, III, 1856, pp. 99, 299.)

Professor Dümichen of Strassburg has discovered at the temple of Dayr el Bahri in Upper Egypt, paintings illustrating the traffic carried on between Egypt and a distant country called Punt as early as the seventeenth century B. C. In these paintings there are representations not only of bags of Olibanum, but also of Olibanum trees planted in tubs or boxes, being conveyed by ship from Arabia to Egypt. Inscriptions on the same building, deciphered by the Professor describe with the greatest admiration the shipments of precious woods, heaps of incense, verdant incense trees, ivory, gold, stimmi (sulphide of antimony), silver, apes and other products not yet identified. The country Punt was first thought to be southern Arabia, but is now considered to comprehend the Somali coast, together with a portion of the opposite Arabian coast. Punt possibly refers to "Opone," an old name for Hafoon, a place south of Cape Gardafui.

A detailed account of frankincense is given by

Theophrastus (B. C. 370–285) who relates that the commodity is produced in the country of the Sabaeans, one of the most active trading nations of antiquity, occupying the southern shores of Arabia (Hist. Plant Lib. 14 ch. 7). It appears from Diodorus that the Sabaeans sold their frankincense to the Arabs, through whose hands it passed to the Phoenicians who disseminated the use of it in the temples throughout their possessions, as well as among the nations with whom they traded. The route of the caravans from south-eastern Arabia to Gaza in Palestine, has recently (1866) been pointed out by Professor Sprenger. Plutarch relates that when Alexander the Great captured Gaza, 500 talents of Olibanum and 100 talents of Myrrh were taken, and sent thence to Macedonia.

A remarkable Greek inscription, brought to light in modern times on the ruins of the temple of Appollo at Miletus, records the gifts made to the shrine by Seleucus II, king of Syria (B. C. 246–227), and his brother Antiochus Hierax, king of Cilicia, which included in addition to vessels of gold and silver, ten talents of frankincense (Libanotos) and one of Myrrh.

The emperor Constantine made numerous offerings to the church under St. Silvester, bishop of Rome C. E. 314–335, of costly vessels and fragrant drugs and spices, among which mention is made in several instances of *Aromata* and *Aromata in incensum*, terms under which Olibanum is to be understood.

With regard to the consumption of Olibanum in other countries, it is an interesting fact that the Arabs in their intercourse with the Chinese, which is known to have existed as early as the tenth century, carried with them Olibanum, Myrrh, Dragon's Blood, and Liquid Storax, drugs which are still imported from the west into China. The first named is called Ju-siang, i.e., milk perfume, a curious allusion to its Arabic name Lubân signifying milk. In the year 1872, Shanghai imported of this drug no less than 1,360 peculs (181,333 Lb.). (Bretschneider, *Ancient Chinese*, London, 1871, 19.)

The fragrant gum resin is distributed through the leaves and bark of the trees, and even exudes as a milky juice from the flowers. Its fragrance is stated to be appreciable at even a considerable distance.

Cruttenden (*Trans. Bombay. Geograph. Soc.* VII, 1846, 121) describes the collecting of Olibanum as follows: "During the hot season the men and boys are daily employed in collecting gums, which process is carried on as follows: About the end of February or beginning of March, the Bedouins visit all the trees in succession and make a deep incision in each, peeling off a narrow strip of bark for about 5 inches below the wound. This is left for a month when a fresh incision is made in the same place, but deeper. A third month elapses and the operation is again repeated, after which the gum is supposed to have attained a proper



degree of consistency. The mountain sides are immediately covered with parties of men and boys, who scrape off the large clear globules into a basket, whilst the inferior quality that has run down the tree is packed separately. The gum when first taken from the tree is very soft, but hardens quickly. . . . Every fortnight the mountains are visited in this manner, the trees producing larger quantities as the season advances, until the middle of September, when the first shower of rain puts a close to the gathering that year."

Carter describing the collection of the drug in southern Arabia, writes thus (*Pharm. Jour.* VIII, 1878, 805): "The gum is procured by making longitudinal incisions through the bark in the months of May and December, when the cuticle glistens with intumescence from the distended state of the parts beneath. The operation is simple, and requires no skill on the part of the operator. On its first appearance the gum comes forth white as milk, and according to its degree of fluidity, finds its way to the ground, or hardens on the branch near the place from which it first issued, from whence it is collected by men and boys employed to look after the trees by the different families who possess the land in which they grow." According to Captain Miles, the drug is not collected by the people of the country, but by Somalis who cross in numbers from the opposite coast, paying

the Arab tribes for the privilege. The Arabian Luban, he says, is considered inferior to the African.

Olibanum as found in commerce varies considerably in quality and appearance. It may in general terms be described as a dry gum-resin, consisting of detached drops or tears up to an inch in length, of globular, pear-shaped form mixed with more or less irregular lumps of the same size. The color of the drug is pale yellowish or brownish, but the finer qualities consist of small tears or drops which are nearly colorless or have a greenish hue. Very small grains are transparent. Examined with a polarizing microscope no trace of crystallization is observable. Olibanum softens in the mouth, its taste is slightly bitter and terebinthinous but by no means disagreeable. Its odor is pleasantly aromatic, but is only fully developed when the substance is exposed to an elevated temperature. Cold water quickly changes the gum resin into a soft whitish pulp which forms an emulsion when rubbed down in a mortar. Immersed in alcohol a tear of Olibanum is not altered much in form but becomes almost pure opaque white in color. In the first case the water dissolves the gum. In the second case the alcohol removes the resin. Dissolved in five parts of water Olibanum yields a neutral solution which is precipitated by perchloride of iron and by silicate of sodium but not by neutral acetate of lead. It is consequently a gum of the same class as gum arabic. The

resin of Olibanum is not soluble in alkalis. Olibanum also contains an essential oil with a boiling point of  $179.4^{\circ}$  Centigrade and an odor resembling somewhat that of turpentine but more agreeable. When the resin is submitted to destructive distillation it affords no umbelliferone. The odor of Olibanum which is developed on heating it has a marked and agreeable lemon like quality. Olibanum was formerly used in medicine in Britain and elsewhere. At the present time the chief market for the consumption of the drug is the demand for the incense used in the Roman and Greek Catholic Churches. Figure 3 shows a branch of Olibanum tree with leaves and buds.

### *Seheleth or onycha*

This fourth constituent of the holy incense mentioned in the Bible is of special interest inasmuch as it is not a product of the plant world at all but is really of animal and mineral origin. The word Seheleth mentioned in Exodus corresponds to the Arabic Sehala which means to peel. The more common Hebrew name for this substance is the Talmudical term Zipporen which literally corresponds to the translation Onycha. Both of these terms denote finger nail or claw. Onycha is the Onyx of Dioscorides and the *Unguis Odoratus* of the Latin writers. It is translated by some of the German writers "Seenagel" and is sometimes called by the Germans Teufelsklaue. K.

Jacob thinks that Onycha is the same as amber; this, however, is an exceptional view. Almost all students of the subject agree that Onycha is the Operculum of a species of Mollusc that abounds in the Red Sea. The operculum is a horny or a calcareous plate attached to the foot of certain gasteropods belonging to the class of Mollusca, the function which is to close the aperture of the shell in which the animal lives and through which it protrudes its so called foot for locomotion. The word suggests a claw or finger-nail shaped object because of the shape of the operculum of a certain species of Mollusc is not unlike a finger-nail in shape. The genus which especially exhibits such an operculum is the genus Strombus. Thus for instance Strombus Fusus is such a mollusc, the Operculum of which is still used as an ingredient of a perfume by the inhabitants of Asia Minor. Another such Mollusc is the Strombus Murex.

Unguis odoratus of the classical and mediaeval writers is sometimes also known as *Blatta Byzantina*. An eminent Latin natural historian Ulyssis Aldrovandus in his voluminous Natural History devotes a chapter in the book De Testaceis to a description of the Blatta Byzantina or the Operculum of the Mollusc which was supposed to have been used in Biblical incense. The beautiful wood cuts found in this work are here reproduced illustrating the shape of some of these Opercula and a page of description is

also here appended giving the Latin text and translation.

According to the same Rondoletius *conchylium* belongs to the class of large cone-shaped shells which are wider at the end that forms the cone and it has neither spines nor protuberances. The opening where the flesh is seen is not round, as in the *purpura* and *buccinum*, but long. Similar also is the shell regarding which he has especially written. In discussing the *purpura* I think we have sufficiently demonstrated that this shell ought to be called the *Blatton* or *Blattion Byzantion* or *Byzantos*. Now we must show that the *Blatta Byzantia* of the Arabians is nothing else than the shell that belongs to the class of *conchylium*; and our pharmacists following the Arabs sell the shells of the *conchylium* and the *Buccinum* together calling them both the *Blatta Byzantia*, though the latter has a round opening and the former an oblong one (Serapio de Simplicibus ch. 91).

Athfar atheb also called *angula aromatica* and the *Blatta Byzantia* of Dioscorides is a shell of the class of oysters, resembling the kind called palpir. It is found near India in waters near which grows the nard. It has the scent of the nard since it feeds upon the nard. It is gathered in the summer when the water has evaporated. A variety is also found along the shores of the black sea. This is fat and it is almost white in color. A smaller variety grows in Babylonia, and is almost black in color. All give forth a good scent when submitted to smoking (heat) resembling somewhat the odor of castoreum. When they are smoked they are beneficial to women suffering from *suffocatio matricis* and also to those suffering from epilepsy. When it is used internally in drink it eases the bowels and accomplishes all that is accomplished by *ostraca de paraca* or *portura*—Serapio repeats all of this when he treats of the shells of the *purpura*. That is all transcribed from Dioscorides. *Unguis* or *onyx* is the shell of a *conchylium* like that of the *purpura* which is found in the nard-producing lakes of India. It gives forth a sweet odor because the animal feeds upon the plant of the nard.

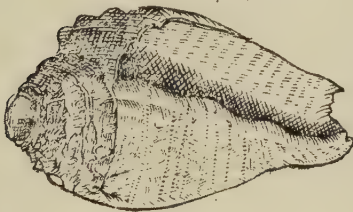
<sup>2</sup> Lib. 3.Conchylia  
guid.

queque completitur: Sic <sup>2</sup> Philostratus in vita Apollonij: Byblus insula parna est apud <sup>1</sup> lados vbi maxima conchylia, muriceq; eximie magnitudinis nasci perhibent. Cum itaq; conchylia, diuer sum esse constet a mucronatis muricibus, nec non à buccinæ: iam quale ipsum sit explicemus. Conchylia, inquit Rondeletius, seruat Græco nomine vocatur à latinis. Sunt qui Ostreacium putent dici. Sed illi nomen partis toti accommodant, vel Plinius nomen totius parti deuicisse enim lib. 32. cap. 10. Inuio apud quosdam ostreaci vocari, quod aliqui onychen vocant. Aronyx (inquit Dioscorides, ἄρονυξ τὸ πρὸς τὸν ὄνυχον, id est operculum conchylj, pro quo etiam ostreacium sumi à Plinio declarat ipsiusmet verba: hoc fustum vuluæ poenis mirè resistere odore castorei, meliusq; cum eo vltum proficere. Quæ eadem sunt cum his, quæ operculo conchylj tribuit Dioscorides. Commendat enim vngues, qui odorem castorei referunt, eorundemq; lusu excitari quadri sexuinas, quæ vuluarum strangulatione conciderint.

## FORMA DESCRIPTION.

**C**ONCHYLIVM secundum eundem Rondeletium est ex magnorum turbidatorum genere, ea parte latius quàm in turbinem deficit, sine aculeis tubercululæ vllis. Foramea quoq; caro interior ostenditur, non rotundum, vrin purpurea & buccino, sed longum. Tale

Conchylum Rondeletij, cum suis operculis, vnâ cum operculo Purpureæ.



Blatta Byzantia Arabum.

etiam est operculum, de quo separatim hæc omnia scripta reliquit. In purpura satis demòstrat se nos arbitror, operculū eius βλαττον siue βλαττον βυζάντιον siue βύζαντος appellari debuisse. Nunc ostendendum nobis est blattam Byzantiā Arabum nihil aliud esse, quam conchylj operculum: quos imitati pharmacopœ nostre conchylionum, buccinorumque opercula permixta vendentes, blattas byzantias vocant, has rotundas, illas longas. Scripio libro de Simplicibus cap. 91. Athysar atheb, id est, vngula aromatica & blatta byzantia Dioscorides, est conchylium ex speciebus Ostreorum & est similiter de conchylj palpis & reperiuntur in regionibus Indiar, in aquis iuxta quas oritur spica nardi. odor autem eius est aromatibus, quoniā istud animal comedit nardum, & ipsa colliguntur tempore æstiuo, quando aquæ desiccantur. Reperiuntur etiam ex eis in littoribus maris Euxini, & color eius est declinans ad albedinem & est purgus.





- A**guis. Sed illa quæ nascitur in Babylonia est coloris subnigri, & est maior illa, & omnes habent bonum odorem quando fumigantur, cum eis sentitur sicut odor castorei. Quando igitur fit fumigatio cum eis mulieri habenti suffocationem matricis, & similiter habenti epilepsiam, confert, & quando bibuntur, molliunt ventrem & faciunt omnes operationes quas faciunt ostraca de paraca, vel portura. Eadem reperit Serapio eodē in libro de Purpurarum operculis agens. Quæ omnia ex Dioscoride transscripta esse nemo est qui neget, si illa cum Dioscoridis verbis contulerit, quæ sunt huiusmodi. Vnguis siue onyx, conchylij tegumentum est, ei simile quo purpura integritur, quod in Indiæ nardiferis lacubus invenitur, suavem ideo spirans odorem, quod conchylija inibi nardi pabulo vescantur. Col-  
**l**igitur posteaquam stagnantes aquæ æstivis squaloribus inaruerunt. Laudatissimus qui à mari rubro defertur, candicans, pinguis. Babylonicus nigrescit, atque minor conspicitur. Ambo odoris gratia suffiuntur, sed aliquatenus castoreum olent. Idem suffitu excitant scē-  
**l**imas vulvæ stragularum oppressas, comitialesque. Porò ventrem molliunt. Hæc Dioscorides quibus planè similia sunt, quæ Serapio de blatta Byzantiæ literis mandavit. Dicitur autem vnguis à figura: est enim operculum oblongum, avium carnivorarum vnguibus si-  
**m**ile. Altera tantum parte adhaerens, id est, crassiore. Quam incenditur, fumum multum emittit, valetq; ad ea quæ tradidit Dioscorides. Sed id propius intueudum quod scribit in Indiæ nardiferis lacubus inveniri, suavemq; ideo spirare odore, quod conchylija inibi nardi pabulo vescuntur, colligiq; posteaquam æstivis squaloribus inaruerunt. Nam si cō-  
**n**chylija marina sint animalia, quomodo in lacubus inveniuntur, colligunturq; aquis æstu exsiccatis? An mare deierunt turbinata, ut fluviis lacusq; subeant? Hæc a Dioscoride ex aliorum intentia dicta esse crediderim, eaq; ex alijs de scripisse, quibus expositis, præfere-  
**e**at, quæ ex mari adferuntur. Sunt qui blattas Byzantiæ negant esse onychas, siue opercu-  
**l**a conchyliorum, quod blattæ Byzantiæ non sint odorata, sed fœtida. Quam opinionem possum facile ex eo refellere, quod Dioscorides non semper *ὄνυχας* vocet id, quod grato solem & iucundo odore placet, sed aliquando id quod vehementi & gravi est odore. Sic præ dicitur ab eo *ὄνυχας*, quam tamen suavis odoris esse nemo dixerit. Sed de hac re plu-  
**r**a alijs dicturi sumus. Quod autem hoc loco *ὄνυχας* recte interpretemur, id maximo est argumento, quod qualitem odoris exprimere volens Dioscorides dixit: *Κυπρίωνος δὲ ὄνυχας, θυμωκεύης, κασιόφιστος ποσὶς τῆ ὀσμῆς*. An hoc gratis odoris (de marino & ba-  
**l**bylonico loquitur) incensu castoreum quodammodo redolent, quod castoreum odore gra-  
**v**i & virus redolent esse debere tradidit idem Dioscorides. Huc accedit quod non nisi a fœtidis rebus factu suffitu, suffocatione vulvæ oppressæ excitantur, neque comitiales. Qua-  
**r**e si quæ blattæ Byzantiæ hodie venduntur a seplasiarijs, grati & suavis odoris non sint, ideo conchyliorum opercula, vel vngues esse non recte iudicaberis. Examinandæ scrupu-  
**l**as alias, quem nobis iniicit Dioscorides cum dicit: Vnguis conchylij tegumentum est, ei simile, quo purpura integritur. Quæ consentire non possunt cum ijs quæ diximus de conchylij operculo, longo strictoque. buccini vero & purpuræ rotundo, nisi hanc simili-  
**t**udinem ad vsum substantiamque, non ad figuram referamus: ut sit sensus: Quemadmodum purpura operculum habet, quo foramen elauditur veluti tellis altera, ita & conchylium, vel substantia viribusque simile est conchylij operculum purpuræ operculo, non autem figura. Hæc sunt quæ de conchylij & buccini operculis dicenda putavi. Hætenus  
**R**ondolentis, ex hibitis vtriusque iconibus, quarum quæ rotunda est, buccini est, cæteræ conchyliorum. Conchylijs succum inesse, inquit idem, purpureum satis testatur Plinius  
**l**ib. 2. cap. 8. Tertius est qui propriè conchylij intelligitur multis modis. Vnus in helio-  
**t**ropio, & in aliquo ex his plerumque saturior: alius in malva ad purpuram inclinans, alius in *violæ* litorina conchyliorum vegetissima. Ex eodem succo lanæ ringi solitas facile est ex veterum scriptis confirmare. Mafællus medicus de effectibus succorum scribens claudendum aurem lana infecto conchylio marino monet: exsiccandi enim vires habet. Et Crito apud Galenum lib. 3. medicam, *κατὰ τὸ πρῶτον*, conchylio infectos succos in aurem immittendos. Plinius per se conchylio infectam lanam magnopere prodesse auri-  
**b**us tradit. Qui conchylija legebant, conchyliari dicebantur, & conchyleguli, & conchy-  
**t**æ à Plauto.

Conchylija opima quæ.

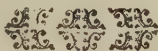
Vnguis cuius sit dictus.

An sint Onyches.

An tegumentum purpuræ.

Succus Conchylij.

Lanæ infectæ cochylis succo vitæ.





The shells are gathered after the waters are dried up by the summer heat. The variety which is brought from the "Red Sea," white in color, and fat, is most highly praised. The Babylonian variety is nearly black and is smaller. Both are submitted to heat for the sake of the odor which somewhat suggests the scent of castoreum. This odor is stimulating to women suffering from *vulvae strangulatio* and to epileptics. A concoction when drunk eases the bowels. Such is the account of Dioscorides. Clearly, what Serapio has written of the *Blatta Byzantia* is very similar.

The name *Unguis* moreover comes from the shape of the shell, for it is oblong and resembles the claw of carnivorous birds. The animal adheres at the thicker end. When the shell is put into fire it emits much smoke which is beneficial in the ailments that Dioscorides mentions. But we must examine more closely what he says of its being found in nard-producing lakes of India, that it gives forth a sweet odor because the animals feed upon the nard and that it is gathered after the waters are dried by the summer heat. If the shells are marine how can they be found in lakes and be gathered when the waters have been dried up by heat? Or do the animals desert the seas to go up into the rivers and lakes? I would suggest that Dioscorides has accepted his opinions from certain authors, and his descriptions from others, and then had given his preference to the marine species.

There are some who say that the *Blatta Byzantia* is not the same as the *onyx* or the *conchylium shell*, because the *Blatta Byzantia* is not sweet-scented but ill-smelling. I can easily refute this opinion, because Dioscorides does not always use the word *euowdes* of a thing that pleases by a sweet and fragrant scent, but he sometimes uses it of things that have a strong and pungent odor. So for instance he uses the word in connection with pitch, a thing which no one would call fragrant. But of this we shall have more to say in another place. That we have the right interpretation of the word here we have excellent proof in the fact that when Dioscorides wishes to express the nature of the scent in question he says (speaking of the Babylonian and marine kinds): both, when put into fire, are *euowdes*, giving out a smell somewhat resembling castoreum—and he himself

described the smell of castoreum as heavy and pungent. To this we may add the fact that only the fumes of fetid things stimulate epileptics and women suffering from *suffocatio vulvae*. Hence if any *Blatta Byzantia* is sold today by pharmacists it has not a pleasing odor, and hence you cannot well deny that it is the *conchylium* shell or the *unguis*.

We must remove another difficulty which Dioscorides raises when he says: "*Unguis* is the shell of the *conchylium* and is like the one by which the *purpura* is covered." This does not agree with what we said about the shell of the *conchylium* which is long and straight while that of the *purpura* and the *buccinum* is round, unless perhaps the author referred to a similarity of quality and properties and not of shape. The *conchylium* resembles the *purpura* in that it has a covering in which the opening is closed as if by a second piece of shell, and the two are also similar in qualities and properties but not in shape. This is what I considered needful to say about the shells of the *conchylium* and the *buccinum*.

Thus Rondoletius: who also gives pictures of both—the round one representing the *buccinum*, the other one the *conchylium*. The same author says that there is a secretion of the *conchylium*, and Pliny (bk. 21. ch. 8) says clearly that this is scarlet (*purpureus*). He says "There is a third color which belongs especially to the *conchylium* but appearing in several shades. One is in the *heliotrope* being frequently very deep in color, another is found in the mallow, verging toward scarlet, another, the most brilliant color of the *conchylium*, is found in late violets." From the writings of the ancients we can readily prove that woolen cloth was dyed with this secretion.

Marcellus medicus writing about the ailments of the ear advises closing the ear with wool soaked in marine *conchylium*, for it has the property of dessicating. Crito in the third book of Galen also advises closing the ear with padding soaked in *conchylium* and Pliny says that wool soaked in *conchylium* is good for the ears. The people who gather *conchylium* are called *conchyliarii*, *conchyleguli* or *conchytae* by Plautus.

It is evident that Onycha is really a mineral constituent derived from an animal source. There is no doubt as to the elaboration of a powerful and agreeable perfume on heating these Opercula. The Orientals and especially Arabs are well known for their delight in perfumery. All kinds of redolent scents are widely used by all Oriental people and especially by those of Asia Minor. A very interesting description of the perfumes employed by Arabian women and of the perfume derived from the Opercula of certain mollusca found in the Red Sea is given by Sir S. W. Baker in his famous work, *The Nile Tributaries of Abyssinia* (London, 1868). This passage is so interesting as throwing light on the subject of Onycha that a page or two from chapter six is here quoted.

"Great attention is bestowed upon perfumery, especially by the women. Various perfumes are brought from Cairo by the traveling native merchants among which those most in demand are oil of roses, oil of sandalwood, essence of a species of Mimosa, essence of musk, and oil of cloves. The women have a peculiar method of scenting their bodies and clothes, by an operation that is considered to be one of the necessities of life and which is repeated at regular intervals. In the floor of the tent or hut, as it may chance to be, a small hole is excavated sufficiently large as to hold a common champagne bottle; a fire of charcoal or of simply glowing embers is made within the hole into which the woman about-to-be-scented throws a handful of various drugs. She then takes off the cloth or tope which forms her dress, and crouches naked over the fumes while she arranges her robe to fall as a mantle from her neck to the ground like a tent. When this arrangement is concluded she is

perfectly happy, as none of the precious fumes can escape, all being kept under the robe, exactly as if she wore a crinoline with an incense burner; the change would be a far more simple way of performing the operation. She now begins to perspire freely in the hut or tent, and the pores of the skin being thus open and moist, the volatile oil from the smoke of the burning perfumes is immediately absorbed. By the time that the fire has expired the scenting process is completed and both her person and robe are redolent of incense with which they are so thoroughly impregnated that I have frequently smelt a party of women a full one hundred yards distant when the wind was blowing from their direction. Of course, this kind of perfumery is only adapted for those who live in tents and the open air. But it is considered by the ladies to have a peculiar attraction for the other sex, as valerian is said to ensnare the genus *felis*. The men are said to be allured by this peculiar combination of sweet smells and to fall victims of the delicacy of their nasal organs. It will be necessary to give the receipt for the fatal mixture to be made up in proportions agreeing to taste;—ginger, cloves, cinnamon, frankincense, sandalwood, myrrh, a species of sea weed that is brought from the Red Sea and lastly what I mistook for shells but which I discovered to be the *horny disc that closes the aperture* when a shell fish withdraws itself within its shell; these are also brought from the Red Sea in which they abound on the shores of Nubia and Abyssinia.’<sup>2</sup>

That opercula of certain molluscs still play a rôle in the perfumery of the Orient can be gathered from the following offering in the year-book of the American Pharmaceutical Association, 1924, Volume 13, page 5.

Operculum of Murex.—The use of the “onyx” of Dioscorides in medicine and perfumery is commonly considered to belong to ancient history. According to B. Petit (*La Parfumerie moderne*, March, 1923, p. 27) the opercula of *Murex ramosus* and *Fascicolaria Trapezia* are still used as an incense and perfume by the Hindu

population of Madagascar. The shells are collected by the native Vozos and the opercula sold under the name of "Fimpys" to the Hindus, who use the ashes for charms. About 200 kg. are yearly exported to the East Indies, where an essence, called "Antar," is extracted. Five grades are sold on the market. The extraction residue is used, together with other ingredients, for the manufacture of "djosticks," brown, friable incense sticks which are used in the houses and mosques. Whether the "djosticks" made in Canton and used in Brahman rites are identical with the Bombay sticks is uncertain.—E. Gerardin. Bull. sci. pharmacol., 31 (1924), 50-2 (M. J.)

#### ADJUVANT CONSTITUENTS ACCORDING TO THE ORAL LAW

##### *Myrrh*

As mentioned in the beginning of this presentation a number of ingredients in addition to the four mentioned in the Bible were incorporated in incense. These will be now described in detail. Myrrh has been used from the earliest times by the ancients as a constituent for incense, perfumes and unguents. This resin comes from several species of trees, the *Camphora Abyssinica* or *Balsamodendron Myrrha*. Myrrh was an ingredient of the holy oils used in the Jewish ceremonial as well as of incense and it was also one of the constituents of the celebrated Kyphi of the Egyptians, a preparation used in fumigations, medicine, and embalming. Myrrh is mentioned commonly in ancient literature in connection with *Olibanum* and where such references are made and

the weights of the constituents are mentioned Myrrh is always used in smaller quantities than the other ingredients.

Of the use of the drug in mediaeval Europe there are few notices, but they tend to show that the commodity was rare and precious. Thus Myrrh is recommended in the Anglo-Saxon Leechbooks to be used with Frankincense in the superstitious medical practice of the eleventh century (Cockayne, *Leechdoms of Early England*, 1865, II, 295.) In a manuscript of the Monastery of Rheinau, near Schaffhausen, Switzerland, we also find that, apparently in the eleventh century, Myrrh as well as Olibanum were used in ordeals in the "judicium aquae bullientis" (Runge, *Mittheilungen cl. Antiq. Ges. Zürich*, 1859, XII, 187). The drug was also used by the Welsh "Physicians of Myddfai" in the thirteenth century. In the Wardrobe accounts of Edward I there is an entry under date 6th January, 1299, for gold, frankincense, and myrrh, offered by the king in his chapel on that day, it being the Feast of Epiphany. The custom is still observed by the Sovereigns of England, and the Queen's oblation of gold, frankincense, and Myrrh is still presented annually on the Feast of Epiphany in the Royal Chapel in London. Myrrh again figures in the accounts of Geoffroi de Fleuri, master of the wardrobe (argentier) to Philippe le Long, king of France, where record is made of the

purchase of—"4 onces d'estorat calmite" (see *Styrax*) "et mierre (myrrh) . . . . . encenz et laudanon," (*Ladanum*, the resin of *Costus creticus* L.)—for the funeral of John, posthumous son of Louis X., A. D. 1316. (*Comptes de l'Argentrerie des rois de France* 1851, 19.)

Gold, silver, silk, precious stones, pearls, camphor, musk, myrrh, and spices are enumerated as the presents which the Khan of Cathay sent to Pope Benedict XII, at Avignon about the year 1342. (*Cathay and the Way Thither*, II, 357.) The myrrh destined for this circuitous route to Europe was doubtless that of the Arabian traders, with whom the Chinese had constant intercourse during the middle ages. Myrrh is in fact still rather largely consumed in China (*Reports of Trade at the Treaty of Ports in China* for 1872, p. 4).

The name Myrrh is from the Hebrew and Arabic *Mar*, meaning bitter, whence also the Greek *myrrha*. The ancient Egyptian *Bola* or *Bal*, and the Sanskrit *Vola* are preserved in the Persian and Indian words *Bol*, *Bola*, and *Heera-bol*, well-known names for myrrh.

Theophrastus speaks of myrrh as of two kinds, solid and liquid. No drug of modern times has been identified with the stacte or liquid myrrh of the ancients. (*Theophrastus Lib. IX*, ch. 4.) That it was a substance obtainable in quantity seems evident from



the fact that 150 pounds of it, said to be the offering of an Egyptian city, were presented to St. Silvester at Rome C. E. 314-335. (Vignolius, *Liber Pontificalis*, 1724, I, 95.)

Myrrh is largely collected as it flows out, incisions, according to Hildebrandt, being never practised. From the information given by Ehrenberg to Ness von Esenbeck, it appears that myrrh when it first exudes is of an oily and then of a buttery appearance, yellowish white, gradually assuming a golden tint and becoming reddish as it hardens (Hanbury and Flückiger, *Pharmacographia*, p. 142). It exudes from the bark like cherry-tree gum, and becomes dark and of inferior value by age. Although Ehrenberg says that the myrrh he saw was of fine quality, he does not mention it being gathered by the natives.

Myrrh consists of irregular roundish masses, varying in size from small grains up to pieces as large as an egg, and occasionally much larger. They are of an opaque reddish brown with dusty dull surface. When broken, they exhibit a rough or waxy fracture, having a moist and unctuous appearance, especially when pressed, and a rich brown hue. The fractured, translucent surface often displays characteristic whitish marks which the ancients compared to the light mark at the base of the fingernails. Myrrh has a peculiar and agreeable fragrance with an aromatic, bitter, and acrid taste. It cannot be finely powdered until de-







prived by drying of some of its essential oil and water; nor when heated does it melt like colophony.

Water disintegrates myrrh, forming a light brown emulsion, which viewed under the microscope appears made up of colourless drops, among which are granules of yellow resin. Alcohol dissolves the resin of myrrh, leaving angular non-crystalline particles of gum and fragments of bark.

Myrrh is a mixture, in very varying proportions, of resin, mucilaginous matters, and essential oil. The resin dissolves completely in chloroform or alcohol, and the colour of the latter solution is but slightly darkened by perchloride of iron. It is but partially soluble in alkalis or in bisulphide of carbon. The resin of myrrh is not capable of yielding umbelliferone like that of galbanum. By melting it with potash, pyrocatechin and protocatechuic acid are produced in small amount. The bitter principle of myrrh is contained in the resin and is extracted by alcohol. Myrrh and its preparations are still official in most Pharmacopoeias. Medically it is a very useful astringent. It has also been used as an expectorant, and in combination with iron and cloves in menstrual disorders.

### *Cinnamon*

The Hebrew word Kinamon and sometimes Kinamon Bosem is almost universally taken to mean

cinnamon. The root is *Knm* denoting to set up or erect or bundle and refers to the bundles or sticks of cinnamon bark which come on the market. There are, however, a few writers like Schoff who are not quite certain whether sticks of cinnamon or of some other plant are meant. (Schoff, *Jour. Am. Oriental Soc.*, 1920, XI, 260.) There can hardly be any doubt whatever that cinnamon is the substance referred to and mention is made of it by all the ancient writers. Cinnamon is the bark of a small evergreen tree of which there are several species belonging to the great family *Lauraceae*. It is a tree richly clothed with beautiful shining leaves and bearing greenish flowers. The best cinnamon bark of our times is the *cinnamomum Zeylonicum* or Ceylon bark. The cinnamon of the ancients however, and especially the cinnamon mentioned by Semitic writers probably was imported from other regions than India. The accounts of Dioscorides, Ptolemy and the authors of the book of *Periplus* state that the cinnamon and cassia which we will describe in a later chapter were obtained from Arabia and Eastern Africa and we further know that the importers were Phoenicians who traded by Egypt and the Red Sea with Arabia. Whether the spice was really a product of Arabia or Africa or whether it was imported from India or China is a question which has excited no small amount of discussion. It was probably imported from different





FIG. 5. CINNAMOMUM ZEYLANICUM BREYN

sources. That it was a product of the Far East is implied by the name *Darchini* (from *dar*, wood or bark, and *Chini*, Chinese) given to it by the Arabs and Persians.

Cinnamon was held in high esteem in the most remote periods of history. In the words of the learned Dr. Vincent, Dean of Westminster, it seems to have been the first spice sought after in all oriental voyages. (*Commerce and Navigation of Ancients in the Indian Ocean*, 1807, II, 512.) Both cinnamon and cassia are mentioned as precious odoriferous substances in the Mosaic writings and in the Biblical books of Psalms, Proverbs, Canticles, Ezekiel and Revelations; also by Theophrastus, Herodotus, Galen, Dioscorides, Pliny, Strabo and many other writers of antiquity; and from the accounts which have thus come down, there appears reason for believing that the spices referred to were nearly the same as those of the present day.

It is also evident that cinnamon was regarded as among the most costly of aromatics, for the offering made by Seleucus II, Callinicus, king of Syria, and his brother Antiochus Hierax, to the temple of Apollo at Miletus, B. C. 243, consisted chiefly of vessels of gold and silver, *olibanum*, *myrrh*, and *costus* included also two pounds of *Cassia* and the same quantity of *Cinnamon*. (*Chishull, Antiquities Asiatic*, 1728, 65-72.)

The earliest notice of cinnamon in connection with Northern Europe that we have met with, is the diploma granted by Chilperic II, king of the Franks, to the monastery of Corbie in Normandy, A. D. 716, in which provision is made for a certain supply of spices and grocery, including 5 pounds of Cinnamon. (Pardessus, *Diplomata*, Paris, 1849, II, 309.)

The extraordinary value set on cinnamon at this period is remarkably illustrated by some letters written from Italy, in which mention is here and there incidentally made of presents of spices and incense. Thus in C. E. 745, Gemmulus, a Roman deacon, sends to Boniface, Archbishop of Mayence ("cum magna reverentia"), 4 ounces of Cinnamon, 4 ounces of Costus, and 2 pounds of Pepper. In C. E. 748, Theophilacias, a Roman Archdeacon, presents to the same Bishop similar spices and incense. Lullus, the successor of Boniface, sends to Eadburga, abbatisa Thanetensis, circa C. E. 732-751—"unum graphium argenteum et storacis et cinnamoni partem aliquam;" and about the same date, another present of cinnamon to Archbishop Boniface is recorded. Under date C. E. 732-742, a letter is extant of three persons to the abbess Cuneburga, to whom the writers offer—"Turis et piperis et cinnamoni permodica xenia, sed omni mentis affectione destinata." (Jeffe. *Bibliotheca Rerum Germanicarum*, 1866, III, 154 etc.)

In the 9th century, Cinnamon, pepper, costus,



cloves, and several indigenous aromatic plants were used in the monastery of St. Gall in Switzerland as ingredients for seasoning fish. (Pharm. Jour. 1877, VIII, 121.)

Of the pecuniary value of this spice in England, there are many notices from the year 1264 downwards. In the 16th century it was probably not plentiful, if we may judge from the fact that it figures among the New Year's gifts to Philip and Mary (1556-57), and to Queen Elizabeth (1561-62). (Nicholls, *Progresses and Processions of Queen Elizabeth*, 1823, I, 118.)

The best cinnamon is produced from a tree distinguished by large leaves of somewhat irregular shape, but the bark of all cinnamon trees possesses the aromatic odor so familiar to everyone. This bark of cinnamon trees is peeled or collected at special seasons.

In consequence of the increased flow of sap which occurs after the heavy rains in May and June, and again in November and December, the bark at those seasons is easily separated from the wood, so that a principal harvest takes place in the spring, and a smaller one in the latter part of the year. The shoots having been cut off by means of a long sickle-shaped hook called a catty, and stripped of their leaves, are lightly trimmed with a knife, the little pieces thus removed being reserved and sold as cinnamon chips. The bark is next cut through at distances of about a foot, and slit lengthwise, when it is easily and completely removed by

the insertion of a peculiar knife termed a *mama*, the separation being assisted, if necessary, by strongly rubbing with the handle. The pieces of bark are now carefully put one into another, and the sticks firmly bound together into bundles. Thus they are left for 24 hours or more, during which a sort of "fermentation" (?) goes on which facilitates the subsequent removal process. This is accomplished by placing each quill on a stick of wood of suitable thickness, and carefully scraping off with a knife the outer and middle cortical layer. In a few hours after this operation, the peeler commences to place the smaller tubes within the larger, also inserting the small pieces so as to make up an almost solid stick, of about 40 inches in length. The cinnamon thus prepared is kept one day in the shade, and then placed on wicker trays in the sun to dry. When sufficiently dry, it is made into bundles of about 30 pounds each.

Ceylon cinnamon of the finest description is imported in the form of sticks, about 40 inches in length and  $\frac{3}{8}$  of an inch in thickness, formed of tubular pieces of bark about a foot long, dexterously arranged one within the other, so as to form an even rod of considerable firmness and solidity. The quills of bark are not rolled up as simple tubes, but each side curls inwards so as to form a channel with in-curving sides, a circumstance that gives to the entire stick a somewhat flattened cylindrical form. The bark composing the



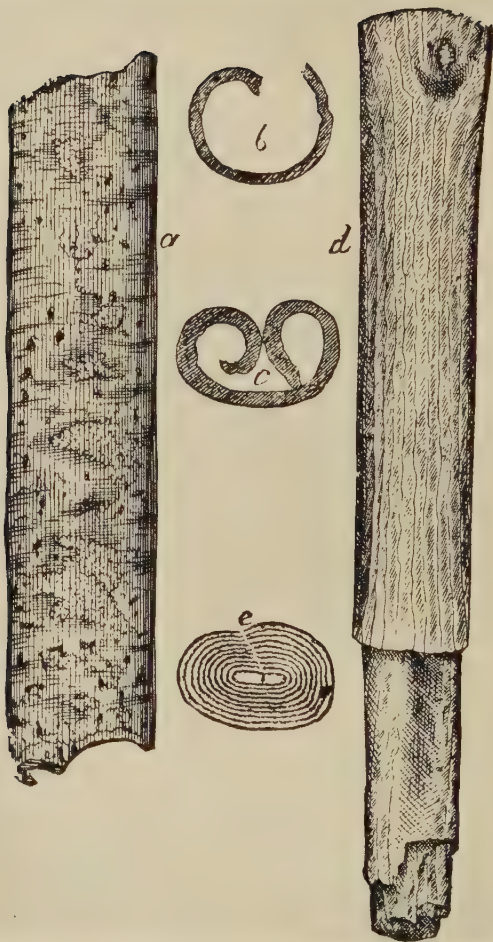


FIG. 6. CINNAMOMUM BARK FROM CHINA AND CEYLON  
*a, b, c, from China; d, e, from Ceylon.*

stick is extremely thin, measuring often no more than  $\frac{1}{16}$  of an inch in thickness. It has a light brown dull surface, faintly marked with shining wavy lines, and bearing here and there scars or holes at the points of insertion of leaves or twigs. The inner surface of the bark is of a darker hue. The bark is brittle and splintery, with a fragrant odour, peculiar to itself and the allied barks of the same genus. Its taste is saccharine, pungent, and aromatic.

The bales of cinnamon which arrive in London are always re-packed in the dock warehouses, in doing which a certain amount of breakage occurs. The spice so injured is kept separate and sold as Small Cinnamon, and is very generally used for pharmaceutical purposes. It is often of excellent quality. The most interesting and important constituent of cinnamon is an essential oil which the bark yields to the extent of 0.5 to 1 per cent. This oil is used as a flavoring agent in medicine and pharmacy. It is a golden-yellow liquid and possesses a powerful cinnamon odor and a sweet aromatic and somewhat burning taste. It turns the plane of polarized light to the left. The chief ingredient of the oil is Cinnamic Aldehyde. Cinnamic Aldehyde is closely related to Benzaldehyde. In a special study conducted by Macht on Benzaldehyde, Cinnamein and related drugs it was found that Cinnamic Aldehyde has the same physiological properties as Benzaldehyde and certain Benzyl Esters. All

of these substances are to a certain extent locally anesthetic and to a very marked extent they are sedative to smooth muscles and act as antispasmodics. (Arch. Internationales de Pharmacologie et Therap. 1922, xxvii, 12.) Cinnamon bark in addition to its oil contains also starch, mannite, mucilage, sugar and tannic acid. Its use in medicine is not only as a flavoring agent and a spice but also to some extent as a cordial and stimulant. On the intestinal tract it acts as a sedative on the one hand and as a carminative expelling gas on the other hand. The subjoined picture shows the appearance of the bark of the Ceylon Cinnamon as compared with Chinese Cinnamon bark which will be considered in the following section on Cassia.

### *Cassia*

Concerning this ingredient there have been a great many discussions and differences of opinion yet it seems to the author that there is really little doubt in regard to its identity. This substance is mentioned under the name of Kiddah in Exodus, chapter 30, verse 24, and another reading is Keziath from Psalm 35 verse 46. The derivation of the first word is from the root Qdd meaning to cut.

The confusion in regard to the identity of the drug is due to a great extent to the fact that the word Cassia in modern languages is applied to two very

different plants: on the one hand we have the *Cassia Fistula* which belongs to the family of Leguminosae and on the other hand we have the *Cortex Cassiae Ligneae* or *Cassia bark* which belongs to the family of Lauraceae and is closely related to cinnamon bark. The *Cassia Fistula* is a well known drug and comes on the market as leaves under the name of *Folia Sennae* or *Senna Leaves*, and as *Fructus Cassiae Fistulae* or *Senna Pods*. The *Senna Leaves* are obtained chiefly from two sources: the two species *Cassia Acutifolia* and *Cassia Angustifolia*.

*Cassia acutifolia* (Delile) is a shrub about two feet high, with pale subterate or obtusely angled, erect or ascending branches, occasionally slightly zigzag above, glabrous at least below. The leaves are usually 4 to 5 jugate; leaflets oval or lanceolate, acute, mucronate, usually more or less distinctly puberulous and glabrous, pale or subglaucous beneath, and subsessile. Stipules are subulate, spreading or reflexed, 1 to 2 lines long. Racemes axillary, erect, rather laxly many-flowered, usually considerably exceeding the subtending leaf. Bracts membranous, ovate or obovate, caducous. Pedicels at length 2 to 3 lines. Sepals obtuse, membranous. Two of the anterior anthers much exceed the rest of the fertile stamens. Legume flat, very broadly oblong, but slightly curved upwards, obliquely stipitate, broadly rounded at the extremity with a minute or obsolete mucro indicating

the position of the style on the upper edge;  $1\frac{1}{2}$  to  $2\frac{1}{4}$  inches long and  $\frac{3}{4}$  to 1 inch broad; valves chartaceous obsoletely or thinly puberulous, faintly transverse-veined, unappendaged. Seeds obovate-cuneate, compressed; cotyledons plane, extending the large diameter of the seed in transverse section.

The plant is a native of many districts of Nubia (as Sukkot, Mahas, Dongola, Berber), Kordofan and Sennaar; grows also in Timbuktu and Sokoto, and is the source of Alexandrian Senna.

*Cassia angustifolia* Vahl—is a species closely related to the preceding, the general description of which is applicable to it with the following exceptions. In this plant the leaflets, which are usually 5 to 8 jugate, are narrower, being oval-lanceolate, tapering from the middle towards the apex; they are larger, being from one to nearly two inches long, and are either quite glabrous or furnished with a very scanty pubescence. The legume is narrower (7 to 8 lines broad), with the base of the style distinctly prominent on its upper edge.

This plant abounds in Yemen and Hadramaut in Sourthern Arabia; it is also found on the Somali coast, in Sind and the Punjab. In some parts of India it is now cultivated for medicinal use.

The uncultivated plant of Arabia supplies the so-called Bombay Senna of commerce, the true Senna Mekki of the East. The cultivated and more luxuri-



ant plant, raised originally from Arabian seeds, furnishes the Tinnevelly Senna of the drug market.

According to the elaborate researches of Carl Martius (*Versuch einer Monographie der Sennablätter* Leipzig, 1867) a knowledge of senna cannot be traced back earlier than the time of the Elder Serapion, who flourished in the 9th or 10th century; and it is in fact to the Arabian physicians that the introduction of the drug to Western Europe is due. Isaac Judaeus, (*Opera Omnia*, Lugd., 1515, lib. 2, chap. 39) who wrote probably about C. E. 850–900 and who was a native of Egypt, mentions senna, the best kind of which he says is that brought from Mecca.

Senna (Ssinen or Ssenen) is enumerated among the commodities liable to duty at Acre in Palestine at the close of the twelfth century (*Recueil des Historiens des Croisades*, 1843, II, 177). In France in 1542 a pound of Senna was valued in an official tariff at 15 sols, the same price as pepper or ginger (Fontanon, *Edicts et Ordonnances des Roys de France*, 1585, ii, 349).

The Arabian and the mediaeval physicians of Europe used both the pods and leaves, preferring however the former. The pods (*Folliculi Sennae*) are still employed in some countries.

In commerce three varieties of Senna leaves are distinguished. 1. Alexandrian Senna is furnished by *Cassia acutifolia*. The leaves have a peculiar opaque,

light yellowish green hue, a somewhat agreeable tea-like odor, and not a very marked taste. 2. Arabian Moka or East Indian Senna, and 3rd Tinnevelly Senna. Chemically modern research has shown that the active laxative principle of Senna are certain derivatives of Anthracene.

The pods of *Cassia Fistula* come from a tree indigenous to India, ascending to 4000 feet in the outer Himalaya, but now cultivated or subsponaneous in Egypt, Tropical Africa, the west Indies and Brazil. It is from 20 to 30 feet high (in Jamaica even 50 feet) and bears long pendulous racemes of beautiful fragrant, yellow flowers. Some botanists have established for this tree and its near allies a separate genus, on account of its elongated, cylindrical indehiscent legume, but by most it is retained in the genus *Cassia*. The pods have also a slight aromatic odor and sickly sweet taste and are also used as laxative medicine.

The name *Cassia* was originally applied exclusively to a bark related to Cinnamon which, when rolled into a tube or pipe, was distinguished in Greek by the word *Syrinx*, and in Latin by that of *Fistula*. Thus Scribonius Largus, (*Compositiones Medicamentorum*, chap. 4, sec. 36), a physician of Rome during the reigns of Tiberius and Claudius, with the latter of whom he is said to have visited Britain, C. E. 43, uses the expression "*Cassiae rufae fistularum*" in the receipt for a collyrium or eyewash. Galen describing the

different varieties of Cassia, mentions that called Gizi as being quite like Cinnamon or even better; and also names a well-known cheaper sort, having a strong taste and odor which is called fistula, because it is rolled up like a tube. (Galen De antidot. I, chap. 14.)

Oribasius, physician to the Emperor Julian in the latter half of the 4th and beginning of the fifth century, describes Cassia fistula as a bark of which there are several varieties, having pungent and astringent properties ("omnes cassiae fistulae vires habent acriter exalficientes et stringentes"), and sometimes used in the place of Cinnamon. (Physica Hildegardis. Argent., 1533, 227.)

It is doubtless the same drug which is spoken of by Alexander Trallianus as Cassia in connection with costus, pepper and other aromatics; and named by other Greek writers as Cassia Syringoides.

There can be very little doubt that the Cassia of Biblical incense was the bark of Cassia Lignea. Various species of Cinnamomum occurring in the warm countries of Asia from India eastward, afford what is termed in commerce Cassia Bark. The trees are extremely variable in foliage, inflorescences and aromatic properties, and the distinctness of several of the species laid down even in recent words is still uncertain.

The bark which bears par excellence the name of Cassia lignea, and which is distinguished on the Conti-

nent as Chinese Cinnamon, is a production of the provinces of Kwangtung, Kwangsi and Kweichau in Southern China.

Theophrastus, Dioscorides, Pliny, Strabo and others, as well as the remarkable inscription on the temple of Apollo at Miletus, represent Cinnamon and Cassia as distinct, but nearly allied substances.

In the list of productions of India on which duty was levied at the Roman custom house at Alexandria, Circa C. E. 176-180, *Cinnamomum* is mentioned as well as *Cassia turiana*, *Xylocassia* and *Xylocinnamomum* (Vincent: Commerce and Navigation of Ancients in the Indian Ocean, 1807, ii, 130 ff.) Of the distinction here drawn between cinnamon and cassia it is difficult to give an explanation; but it is worthy of note that twigs and branches of a *Cinnamomum* are sold in the Chinese drug shops, and may not improbably be the *xylocassia* or *xylocinnamon* of the ancients. The name *Cassia lignea* would seem to have been originally bestowed on some such substance, rather than as at present on a mere bark. The spice was also undoubtedly called *Cassia syrinx* and *Cassia fistularis*—names which evidently refer to a bark which had the form of a tube. In fact there may well have been a diversity of qualities, some perhaps very costly. It is remarkable that such is still the case in China, and that the wealthy Chinese employ a thick variety of Cassia, the price of which is as much as \$18.00 per catty, or about 56s. per lb.

Whether the Aromata Cassiae, which were presented to the church at Rome under St. Silvester, C. E. 314–335, was the modern cassia bark, is rather doubtful. The largest donation, 200 lb., which was accompanied by pepper, saffron, storax, cloves, and balsam, would appear to have arrived from Egypt. (Vignolius, *Liber Pontificalis*, 1724, I, 94.) Cassia seems to have been known in Western Europe as early as the seventh century, for it is mentioned with Cinnamon by St. Isidore, archbishop of Seville. (Migne. *Patrologiae Cursus*, 1850, Vol. 82, p. 622.) The spice was then sold in London as Canel in 1264, at 10d. per lb., sugar being at the same time 12d., cumin 2d., and ginger 18d. (Rogers. *Hist. of Agriculture in England*, 1866, ii, p. 543.) In the *Boke of Nurture*, written in the 15th century by John Russell, Chamberlain of Humphry, Duke of Gloucester, cassia is spoken of as resembling cinnamon, but cheaper and commoner, exactly as at the present day.

Chinese Cassia lignea, otherwise called Chinese Cinnamon, which of all the varieties is that most esteemed, and approaches most nearly to Ceylon cinnamon, arrives in small bundles about a foot in length and a pound in weight, the pieces of bark being held together with banks of bamboo. The bark has a general resemblance to cinnamon, but is in simple quills, not inserted one within the other. The quills moreover are less straight, even and regular, and are

of a darker brown; and though some of the bark is extremely thin, other pieces are much stouter than fine cinnamon,—in fact, it is much less uniform. The outer coat has been removed with less care than that of Ceylon Cinnamon, and pieces can easily be found with the corky layer untouched by the knife.

Cassia bark breaks with a short fracture. The thicker bark cut transversely shows a faint white line in the centre running parallel with the surface. Good cassia in taste resembles cinnamon, than which it is not less sweet and aromatic, though it is often described as less fine and delicate in flavor.

Cassia bark owes its aromatic properties to an essential oil which is chemically identical with the oil of Cinnamon. However, certain other minor constituents of this plant make the odor of Cassia bark somewhat different from cinnamon. It is well known to all those interested in perfumes that the blending of various aromatic properties is of the greatest importance in producing some of the most agreeable and exquisite perfumes. The aromata given off by cassia and cinnamon were probably quite distinct, although resembling each other.

### *Saffron*

Saffron or as it is known officially *Crocus* was used by the ancients quite extensively both as a perfume or spice and as a coloring matter. The word Saffron is

derived from the Arabic *Asfar* meaning yellow. *Crocus Sativus* from which Saffron is obtained is a small plant with a fleshy bulb-like corm and grassy leaves, much resembling the common Spring *Crocus* of the gardens, but blossoming in the autumn. It has an elegant purple flower, with a large orange-red stigma, the three pendulous divisions of which are protruded beyond the perianth.

*Crocus* is supposed to be indigenous to Greece, Asia Minor, and perhaps Persia, but it has been so long under cultivation in the East that its primitive home is somewhat doubtful.

Saffron, either as a medicine, condiment, perfume, or dye has been highly prized by mankind from a remote period, and has played an important part in the history of commerce.

Under the Hebrew name *Karkom*, which is supposed to be the root of the word *Crocus*, the plant is alluded to by Solomon; and as *Krokos*, by Homer, Hippocrates, Theophrastus, and Theocritus. Virgil and Columella mention the saffron of Mount Tmolus; the latter also names that of *Corycus* in Cilicia, and of Sicily, both which localities are alluded to as celebrated for the drug by Dioscorides and Pliny.

Saffron was an article of traffic on the Red Sea in the first century; and the author of the *Periplus* remarks that *Krokos* is exported from Egypt to Southern Arabia, and from *Barygaza* in the gulf of Cambay



(Lassen, Indische Alterthumskunde, 1857, Vol. iii, p. 52.) It was well known under the name *kunkuma* to the earlier Hindu writers.

It was cultivated at Derbend and Ispahan in Persia, and in Transoxania in the 10th century, whence it is not improbable the plant was carried to China, for according to the Chinese it came thither from the country of the Mahomedans. Chinese writers have recorded that under the Yuen dynasty (C. E. 1280–1368), it became the custom to mix Sa-fa-lang (Saffron) with food. (Bretschneider, Chinese Botanical Works, 1870, 15.)

Saffron was employed in ancient times to a far greater extent than at the present day. It entered into all sorts of medicines, both internal and external; and it was in common use as a coloring and flavoring ingredient of various dishes for the table. The drug, from its inevitable costliness, has been liable to adulteration from the earliest times. Both Dioscorides and Pliny refer to the frauds practised on it, the latter remarking—"Adulteratur nihil aequè."

During the middle ages the severest enactments were not only made, but were actually carried into effect, against those who were guilty of fraudulent substitutes for saffron, or even of possessing the article in an adulterated state. Thus at Pisa, in C. E. 1305, the *fundacarii*, or keepers of the public warehouses, were required by oath and heavy penalties to de-



nounce the owners of any falsified saffron consigned to their custody. (Bonaini, Statuti in Editi della citta di Pisa, 1857, iii, 101.)

The Pepperers of London about the same period were also held responsible to check dishonest tampering with saffron. (Riley, Memorials of London, etc., in 13th and 15th centuries, 1868, 120.)

In France, an edict of Henry II, of 18th March, 1550, recites the advantages derived from the cultivation of saffron in many parts of the kingdom, and enacts the confiscation and burning of the drug when falsified, and corporal punishment of offenders. (Dela Mare. *Traite de la Police*, Paris, 1719, iii, 428.)

The authorities in Germany were far more severe. A Safranschau (Saffron inspection) was established at Nuremberg in 1441, in which year 13 pound of Saffron was publicly burnt at the Schönen Brunnen in that city. In 1444, Jobst Findeker was burnt together with his adulterated saffron! And in 1456, Hans Kölbele, Lienhart Frey, and a woman, implicated in falsifying saffron, were buried alive. The Safranschau was still in vigour as late as 1591: but new regulations for the inspection of saffron were passed in 1613. There was also in the same city a Gewürzschau, or Spice-inspection, from 1441 to 1797. Similar inspections were established in other German towns during the middle ages. (Roth: *Geschichte des Nürnbergischen Handels*, 1800-1802, IV, 221.)

Commercial saffron (Hay Saffron of the druggists) is a loose mass of threadlike stigmas, which when unbroken are united in threes at the upper extremity of the yellow style. It is unctuous to the touch, tough and flexible; of a deep orange-red, peculiar aromatic smell, and bitter and rather pungent taste. It is hygroscopic and not easily pulverized; it loses by drying at 100° C. about 12 per cent of moisture, which it quickly reabsorbs.

The colouring power of saffron is very remarkable: it was found that a single grain rubbed to fine powder with a little sugar will impart a distinct tint of yellow to 700,000 grains (10 gallons) of water.

The flower of Saffron or crocus has a style 3 to 4 inches long, which in its lower portion is colorless, and included within the tube of the perianth. In its upper part it becomes yellow, and divides into three tubular, filiform, orange-red stigmas, each about an inch in length. The stigmas expand towards their ends, and the tube of which they consist is toothed at the edge and slit on its inner side. The stigma is the only part officinal, and alone is rich in colouring matter.

The peculiar coloring matter of Saffron is known as Polychroit; but in 1851 Quadrate, who instituted some fresh researches on the drug, gave it the name of Crocin, which was also adopted in 1858 by Rochleder.

Saffron is of no value for any medicinal effects, and



FIG. 7. CROCUS SATIVUS OR SAFFRON  
(From Baillon's Dictionary, Volume II, pp. 273)



retains a place in the pharmacopoeia solely on the ground of its utility as a colouring agent. A peculiar preference for it as a condiment exists in various countries, but especially in Austria, Germany, and some districts of Switzerland. This predilection prevails also to some extent in England—at least in Cornwall, where the use of saffron for colouring cakes is still common. Saffron is largely used by the natives of India in religious rites, in medicine and for the colouring and flavouring of food.

These historical anecdotes are good illustrations of the importance which was attached to spices and incense in olden times.

### *Nard*

The substance denoted in the Talmud by the name of Shibboleth Nard is translated by some Spikenard and is taken to be *Nardostychos Jatamanse*. This is sometimes known as Indian Nard and is related to the drug Sumbul still used in medicine. Sumbul comes from *Ferula Sumbul* a plant related to Valerian. The Nard of Biblical Incense, however, was probably derived from an entirely different source. The most probable identity of this ingredient is with one or more of the spices of *Andropogon* are the following:

1. *Andropogon Nardus* L.,—a noble-looking plant, rising when in flower to a height of 6 or more feet, extensively cultivated in Ceylon and Singapore for the production of Citronella Oil.

2. *A. citratus* D. C., or Lemon Grass,—a large coarse glaucous grass, known only in a cultivated state, and very rarely producing flowers. It is grown in Ceylon and Singapore for the sake of its essential oil, which is called Lemon Grass Oil, Oil of Verbena, or Indian Melissa Oil; it is also commonly met with in gardens through-out India and is not infrequent in English hothouses. In Java it is called Sireh.

3. *A. Schoenanthus* L., a grass of Northern and Central India, having leaves rounded or slightly cordate at the base, yielding by distillation the oil known as Rusa Oil, Oil of Ginger Grass or of Geranium.

The aromatic properties of the various species of the *Andropogon* were well known to the ancients. *Andropogon* was used extensively in Arabia and elsewhere for purposes of purification.

Grass oils are much esteemed in India as an external application in rheumatism. Rusa oil is used to stimulate the growth of the hair. Internally, grass oil is sometimes administered as a carminative in colic; and an infusion of the leaves of lemon grass is prescribed as a diaphoretic and stimulant. In Europe and America the oils are used almost exclusively by the soapmakers and perfumers.

The most remarkable use made of any grass oil is that for adulterating Attar of Rose in European Turkey. The oil thus employed is that of *Adropogon*





FIG. 8. ANDROPOGON NARDUS L.



*Schoenanthus* L.; and it is a curious fact that its Hindustani name is closely similar in sound to the word rose. Thus under the designation *Rusa*, *Rowsah*, *Rosa*, *Rosé*, *Roshé*, it is exported in large quantities from Bombay to the ports of Arabia, probably chiefly to Jidda, whence it is carried to Turkey by the Mohammedan pilgrims.

Figure 8 is a good illustration of *Andropogon Nardus*. On examining this picture one can clearly understand how the plant was called *shibboleth Nard* inasmuch as it bears a marked resemblance to oats.

Oil of *Citronella* is well known in the United States for its efficiency as an insecticide. This oil was found by Gladstone (1872) to be composed chiefly of an oxidized oil which he called *Citronellol* and which he separated by fractional distillation into two portions, one boiling at  $202^{\circ}$  to  $205^{\circ}\text{C.}$ , the other at  $190^{\circ}$  to  $202^{\circ}\text{C.}$  The empirical formula is indicated as  $\text{C}_{10}\text{H}_{16}\text{O}$ : According to Wright (1874) it is  $\text{C}_{10}\text{H}_{18}\text{O}$  and boils at  $210^{\circ}\text{C.}$  The following is an extract from Schimmel and Company's latest description of *Citronellol*.

*Citronellol* forms a highly important constituent of *Attar of Roses* as well as of *Geranium* oils and possesses a rose-like odour far superior to *Geraniol* in sweetness and constancy. It has taken a firm footing in high-class perfumery and may be said to occupy the most prominent place among rose odours generally.

The characteristic properties of our pure *Citronellol*

are as follows:—specific gravity 0.858 to 0.869 at 15°; optical rotation between +4° and -4° 20', boiling point 225 to 226°. Soluble in about 15 vol. of 50 per cent (12 deg. U. P.) and 3 to 4 vol. of 60 per cent (5 deg. O. P.) alcohol.

### *Costus*

This substance called in Hebrew either Qost or Kost is an important ingredient of spice and incense mentioned in the literature of different nations of antiquity. Its exact identity, however, is very hard to establish. According to some authorities Costus is *Costus Corticosus*, or *Costus Dulcis* which is nothing more than *Canella bark* or the bark of the so-called white Cinnamon. *Costus Alba* or white cinnamon is a tree from 20 to 30 or even more feet in height. Its chief home, however, is on the Western continent and it is very doubtful whether the bark of white cinnamon was ever used in Asia and Europe. *Costus* is more probably the root of the *Aucklandia Costus*, which is a plant very similar to *Elecampane* both in external appearance and structure. *Dioscorides* in speaking of *costus* root says that it is often mixed with that of *Elecampane*. *Elecampane* itself or *Radix Inulae* has been used in ancient medicine. It has a weak aromatic odor suggestive of *Orris* and *Camphor* and a slightly bitter not unpleasant taste. In a letter written to the author by the late Prof. Paul Haupt on

February 3rd, 1921, the eminent scholar wrote the following:

“For *qost* or *kost* (*radix costi*, Pliny 12, 41; of. Horace, *Carmina* 3, 1, 41) you may compare Jastrow’s Talmudic dictionary, pp. 678a and 1344b; Samuel Krauss, *Griechische und lateinische Lehnwörter im Talmud* 1, 282. In Syriac this word appears as *qusta*, also as *qustos* or *qostos*. In Arabic we have *qust*. In addition to *qost* and *kost* we find also *kesarta*. Some think that *quidda lebana*, (Erub, 34b; Kil, 1, 8) denotes *costus*. *Qidda*, which is supposed to be *Laurus cassia*, is found in Exod. 30, 24; Ezek, 27, 19. The Greek Bible has *iris*, *orris*, for *qidda* in Exod. 30, 24. The odor of *costus* root resembles that of *orris* root. The English Bible has *cassia*, not only for *qidda* in Exod. 30, 24; Ezek, 27, 19, but also for *qeciot* in Psalm 45, 9. The *Encyclopaedia Britannica*, 11th ed. vol. 25, p. 668a, 1.1 states that the nard ointment contained *costus* (the root of *saussures lappa*). In vol. 13, p. 349a, 1.16 *costus* is said to be the root of *Aucklandia Costus* (Falconer) and is identified with Heb. *qeciot*.”

### *Calamus Aromaticus*

The Hebrew word *Quillufah* is sometimes rendered as *Calamus* and sometimes as *sweet flag*. This is a well known plant belonging to the class of Aroideae. Its official name being *Acorus Calamus*. The “sweetness” of the *Calamus* leaves pertains more to the odor

rather than to the taste, the taste being rather bitterish and pungent; but the odor on the other hand is aromatic and very pleasant.

*Acorus Calamus* L., is an aromatic, flag-like plant, growing on the margins of streams, swamps, and lakes from the coasts of the Black Sea, through Southern Siberia, Central Asia, and India, as far as Amurland, Northern China, and Japan; indigenous also to North America.

The Sweet Flag root has been from the earliest times a favourite medicine of the natives of India, in which country it is sold in every bazaar. Ainslie asserts that it is reckoned so valuable in the bowel complaints of children that there is a penalty incurred by any druggist who will not open his door in the middle of the night to sell it, if demanded: (*Mat. Med. of Hindoo-stan and Madras*, 1813, 54).

The descriptions of *Acoron*, a plant of Colchis, Galatia, Pontus, and Crete, given by Dioscorides and Pliny, certainly refer to this drug. It is thought that the *Kalamos aromaticos* of Dioscorides, which he states to grow in India, is the same, though Royle regards it as an *Andropogon*, and the *Kalamos* of Theophrastus and the *Calamus* of the English Bible are considered by some authors to refer to the Sweet Flag.

Celsus in the first century mentions *Calamus Alexandrinus*, the drug being probably then brought from India by way of the Red Sea. We know by the testi-



FIG. 9. ACORUS CALAMUS L.  
(After Luerssen)



mony of Amatus Lusitanus (In Diosc. de Mat. Med., 1554, 33) that in the sixteenth century it used to be so imported into Venice. Rheede, moreover, described and figured *Acorus Calamus* as an Indian plant under the name *Vacha*, which it still bears on the Malabar Coast (*Hortus Malabar*, XI, 1692, 48). In the pharmaceutical tariff of the German town of Halberstadt of the year 1697, "*Calamus aromaticus verus*," "*Indianischer Calmus*," and "*Calamus aromaticus nostras*," common *Calmus*, are quoted at exactly the same price (*Flückiger, Documente*), and Murray states expressly that in his time (1790) Asiatic *calamus* was still met with in the pharmacies of Continental Europe, but that it had mostly been replaced by the home-grown drug (*Murray, Apparatus Medic V. 40*). At the present time the *Calamus Aromaticus* of commerce is European; in all essential characters it agrees with that of India, a package of which is now and then offered in the London drug sales.

The rootstock of sweet flag occurs in somewhat tortuous, subcylindrical or flattened pieces, a few inches long, and from  $\frac{1}{2}$  to 1 inch in greatest diameter. It is usually rough and shrunken, varying in color from dark brown to orange-brown, breaking easily with a short corky fracture, and exhibiting a pale brown spongy interior. The odour is aromatic and agreeable; the taste, bitterish and pungent.

The subjoined figure is a very good illustration of *Acorus Calamus*.

## THE COMPOUNDING OF THE VARIOUS INGREDIENTS

The enjoyment of fine odors has not received attention that is given to music or painting or other arts; yet it plays an important part in most peoples' lives influencing their actions and giving them pleasure or perhaps distress. The most exquisite perfumes, as is well known to all those who are interested in the subject, are not the simple odors but the so-called compounded or blended odors which require most painstaking effort and skill for their production. By combining or blending a number of odors in one compound some of the most exquisite and sweetest perfumes are obtained. According to Prof. M. T. Bogert, of Columbia University in an address before the American Chemical Society, we have "symphonies" not only of music or sound but also of odors. Dr. Bogert maintains that each perfume produces the one effect on the olfactory cells peculiar to itself as music notes have their peculiar effects upon the ear, and therefore odors can be arranged according to a scale like music notes are arranged in a gamut. By combining such odors in a harmonious way new effects can be produced which have powerful physiological effects.

It is therefore not at all surprising that in the preparation of biblical incense a number of ingredients were used and these were directed to be compounded



or mixed together in special ways. The preparation of the biblical incense was done in a golden mortar and the finished product, as would be expected, was prohibited for any secular use. The particular blending of the various ingredients was reserved for the use only in the Holy Temple. In the compounding of the various ingredients a number of additional extractives and correctives were employed. Of these the following must be mentioned. (a) Cyprian Wine or vinum Capparinum was used in the preparation of incense. The purpose of this ingredient from a chemical point of view is quite evident. Alcohol is one of the best extractives in the hands of the organic chemist and is especially effective in extracting volatile oils and other odoriferous principles. (b) Borith of Karshina or the lye or alkali from the place called Karshina was also used in the extraction of the various ingredients. This again agrees well with modern chemical technic where alkalis are used extensively for chemical extractions. (c) Salt of Sodom. This was salt from the Red Sea. Sodium Chloride is also well known as a solvent in organic chemistry and solutions of it are often used for making various extracts. (d) Kippat ha-Iarden. The identity of this substance is somewhat doubtful. According to some authorities this is *ambergris* which has been known from time immemorial as an odoriferous substance and used as a "fixative" in the preparation of perfumes. Amber-

gris is a secretion from the stomach of the whale and is found floating in large lumps on the water of the sea. The substance is expensive but is still very highly prized by manufacturers of perfumes. It possesses an agreeable odor described by some as a combination of violets and sweet honey. It is difficult however to see how ambergris could get into the Jordan River, and furthermore it is very doubtful that an animal secretion of such a nature would be incorporated in the holy incense. According to other authorities this Kippat is an aquatic plant growing along the Jordan River which possesses certain odoriferous qualities and was added to other ingredients in the preparation of incense. (e) A grass was added to the incense known as Ma'aleh ashan. The purpose of this ingredient is definitely stated. It is described as producing fumes or a smoke having a peculiar property of ascending directly upward in a straight line. This was added to insure proper rising of the incense fumes. Such a constituent is not at all surprising in the light of some of the recent chemical findings. Smokes or fumes of various kinds have been used in recent years for producing "screens" as for instance in naval warfare and for ornamental and artistic purposes as for instance in connection with the writing of letters in the air by aviators. The chemical compound titanium-tetrachloride has been used extensively of late by aviators for writing letters in the air and this effective method of propaganda is familiar to all.

The blending and compounding of the incense required great practice and skill. The Talmud tells us that this specialty belonged to the family of Abtinath. In Yoma 38 *a* we read an interesting account shedding light on the noble character of its members. We are told that Beth Abtinath or family of Abtinath were skilled in the making of sacred incense, and were so conscientious about their work that no bride belonging to that family ever went to her nuptials with any perfume on her, and when a male member of the family took a bride from another family, a stipulation was always made that the newly wed should abstain from the use of perfumes in the future; all this, in order that people may not gossip and say that the ladies of Abtinath diverted some of the holy incense ingredients to their personal use, and in order to conform in both letter and spirit to the words of the Holy Writ: "Ye shall be clear before the Lord and before Israel." (Numbers XXXII, 22.)

#### PHARMACOLOGICAL ASPECTS OF INCENSE

From a pharmacological point of view incense is especially interesting in two respects. First, in regard to its antiseptic properties, secondly, in regard to its effects on the nervous system, and more particularly on the psychological functions, through the sense of smell. The author in collaboration with some colleagues has carried out a series of original experi-

mental investigations on both subjects which it is well to summarize in this place.

#### CONCERNING THE ANTISEPTIC AND BACTERICIDAL ACTION OF SOME AROMATIC FUMES

The World War was instrumental, in connection with the impetus given to the search for antiseptics and parasitocides, in calling attention to the powerful antiseptic and germicidal properties of various essential oils; as for instance so well described by Cavel (Comp. rend. biol., 1918, 166, p. 827) and Frankel (Therap. Monatshefter, June 1915). This antiseptic action of volatile oils was undoubtedly responsible for the remarkable medicinal virtues of various *balsams* used in ancient times, especially in the treatment and healing of wounds. An ethnological study of the habits and customs of ancient peoples, especially in the Orient, cannot fail to call attention to the extensive employment of incense, perfumes and fumigations among these peoples. Incense was burned in connection with the religious and sacrificial offerings on the one hand, and for esthetic purposes in private homes on the other. Even now powerfully odoriferous substances are in great vogue in the Orient as perfumes and not only are such drugs applied to clothing but very frequently the orientals fumigate their naked bodies directly with the smoke of aromatic herbs and spices, burned over glowing coals. These circum-

stances suggested the possibility that such perfumes and fumes may serve a hygienic as well as esthetic purpose, by exerting an inhibitory effect on the growth and spread of microorganisms. Accordingly some experiments were undertaken in order to ascertain the value of such an hypothesis by the author with the assistance of Dr. Willaim M. Kunkel (Proc. Soc. Exp. Biol. and Med. 1920, 18 p. 68).

The authors subjected a number of gums, spices and other odoriferous substances to destructive dry distillation by heat and studied the effects of the fumes produced thereby on bacterial cultures. The following substances were investigated; gum olibanum, gum galbanum, storax, myrrh, saffron, cinnamon, benzoinum and various samples of domestic and Japanese incense. The various substances were heated in glass test tubes over a flame and the fumes were allowed to come in contact with various microorganisms, care being taken to exclude the germicidal effects of steam. The bacteria studied were: *B. coli*, and *B. pyocyaneus*. In one series of experiments smears were made with living organisms on agar slants; then a given fume was poured into or over the test tube and the culture incubated. In another series of experiments agar or gelatin plates were inoculated with the bacteria and allowed to remain open under a glass bell jar, in which incense was burned. In still another series of experiments the various spices in

powdered form, individually or in combination with each other, were incorporated in culture media and then an attempt was made to grow bacteria on these media. Control experiments were made by burning filter paper (cellulose), raw cotton and various woods.

The results of the experiments showed that the fumes of most of the gums and spices studied, notably gum galbanum, gum olibanum, cinnamon and saffron prevented the growth of freshly transplanted bacteria, in other words, exerted a distinct antiseptic action. When however such fumes were poured over or brought in contact with fully grown or luxuriously developed cultures of *B. pyocyaneus* and especially of *B. coli* the germicidal effect was not so marked. This was possibly due to the poor penetration of the fumes and the volatile oils, etc., carried over by them, into the deeper layers of the cultures.

It was not surprising to note that fumes produced by destruction of various woods gave similar results. Pure cellulose however was not antiseptic in this respect.

Inoculation of bacteria into culture media impregnated with the various aromatics produced a distinct inhibitory effect on their growth.

The burning of various forms of incense, especially of Japanese origin produced a distinct antiseptic effect, and inhibited the growth of organisms freshly inoculated on plates, which were exposed to such fumes

in partially closed chambers, for periods varying from ten to thirty minutes.

While the experiments above reported were of a crude character the results obtained were of so uniform a nature, that the authors were inclined to conclude that the fumes produced by the burning or destructive dry distillation of various gums, spices, and other aromatic substances of a similar nature, certainly tend to exert an antiseptic action on the bacteria studied. This is of course of interest not only from the scientific point of view, but also to the historian, as offering a possible explanation for the extensive employment of incense in connection with sacrificial rites, etc.

#### EXPERIMENTAL PSYCHOLOGY

In nearly all pharmacopeias, ancient and modern, there are included a group of drugs which are characterized by a very powerful odor and which have been and which are still employed as nerve sedatives and and analeptics. Among the best known of such drugs are valerian, asafetida, musk and lavender. The therapeutic employment of these drugs in such conditions—and it must be admitted that they are undoubtedly often effective—is a purely empirical one inasmuch as their beneficial action has never been definitely substantiated by experimental proof in the laboratory.



In connection with a study of the effect of various drugs on the behavior of rats in the circular maze it occurred to the author that possibly the mode of action of the above drugs which are described by most modern writers on pharmacology as "often effective, presumably by olfactory and psychic reflexes" might be studied in a new way. It was thought possible that these substances exert their therapeutic effects not by being first absorbed into the circulation, but through a direct stimulation of the olfactory sense organs and through olfactory organs reflexly affecting other portions of the brain. Accordingly this hypothesis was put to the test in a long investigation by the author and Dr. Giu Ching Ting. (Jour. of Pharmacol. and Exp. Therap., 1921, Vol. 18, p. 361.)

#### METHOD

The mode of experimentation has been fully described by the author in previous papers. (Macht and Mora, Jour. of Pharmacol. and Exp. Therap., 1920, Vol. 16, p. 219.) Young adult albino rats are trained in the circular maze, which briefly consists of a series of concentric circular runways with communicating passages and cul-de-sacs, through which the animal is taught to thread its way to the center of the apparatus where food is placed. Healthy animals of good stock usually learn the maze problem within two weeks and are able to find their way quickly,



without hesitation and without committing any errors, to the center of the maze. After the animals have been trained and their normal running time and behavior has been ascertained in a given experiment, they are treated with the drugs to be studied and the subsequent behavior is again observed.

#### *DESCRIPTION OF THE MAZE*

The circular maze shown in figure 10 is made with wooden base and aluminum walls. The base is 150 cm. in diameter and 4 cm. in thickness. Its upper surface is marked off by grooves into a series of concentric circles. The diameter of each of the circles is as follows, beginning with the outermost one; 140 cm., 120 cm., 100 cm., 80 cm., 60 cm., 40 cm., and 20 cm. Into the circular grooves are inserted sheets of aluminum 18.5 cm. high and 0.8 mm. thick. Each strip of aluminum is cut just 10 cm. shorter than the length of the circular groove into which it is to fit thus giving an opening into the alley. By means of this arrangement it is possible to slide the aluminum around in its groove and thus to place the entrance in any desirable position. In the present investigation, the openings or entrances to the alleys were placed in the position indicated in figure 10, there being 7 openings so arranged that the rat had to make alternate turns to right and left, in the order indicated by Nos. 1 to 7. In addition to the doors or openings, the alleys are

provided also with obstructing partitions, which form a number of blind cul-de-sacs. A wire screen half of which is shown (*W*, fig. 11), prevents the animals from crawling over the top.

The study of the behavior of the rats in the circular maze is begun by placing an animal in the center of the maze and feeding it from the bowl *F* for three successive days. During these three preliminary feedings, which last for ten to fifteen minutes, the entrance 7 is blocked off, so that the animal may not roam around. On the fourth day, the rat is placed in the cage *E*, then the trapdoor *T* is raised and the animal allowed to enter the first alley. The animal then gradually learns to find its way to the center of the maze, when it is taken out and the experiment is repeated. Generally three trials are made on each day. For work with the maze, albino rats, which are very tame, must be employed. The animals must be handled gently with the hands and under no circumstances must they be picked up with forceps or similar instruments. The most suitable animals are found to be rats of approximately sixty to ninety days old. Older animals are apt to be sluggish, while very young rats do not learn the maze problem so readily. Ordinarily the albino rats learn the maze problem in about two weeks, and sometimes within a shorter period of time. An animal is considered to have solved the maze problem when it has learned to find

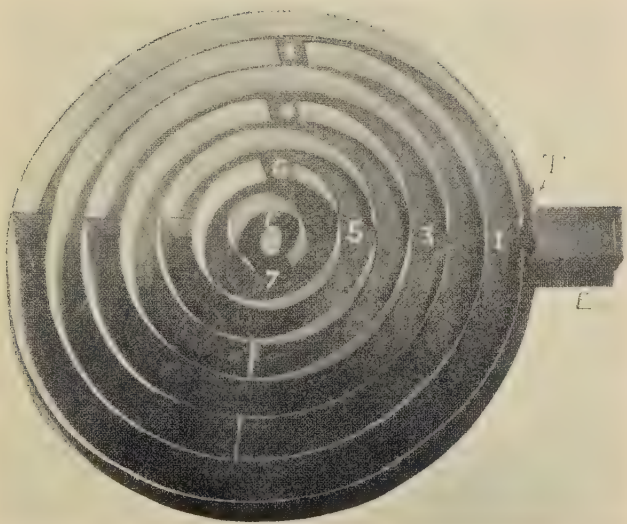


FIG. 10. CIRCULAR MAZE SHOWING THE RUN-WAY AND BLIND ALLEYS

*E*, entrance cage; *T*, trap door leading into first alley; Nos. 1 to 7 indicate the gates to the successive alleys; *F*, food.

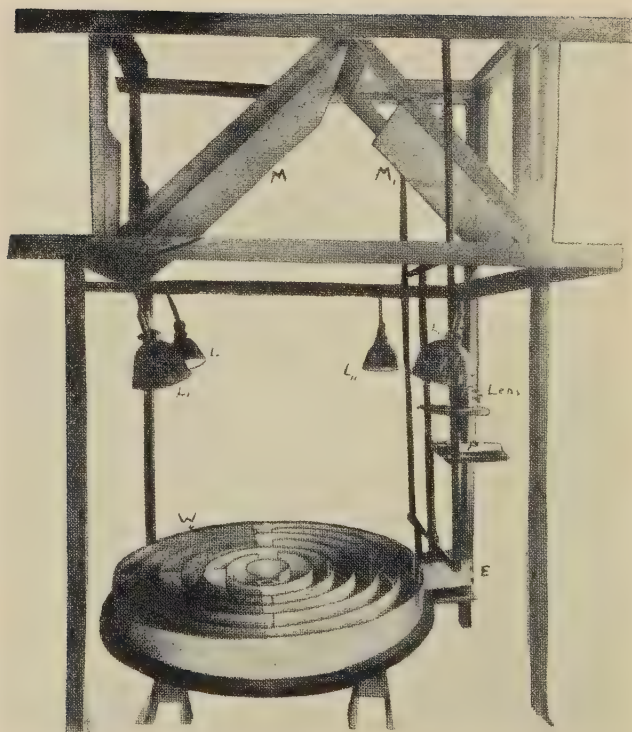


FIG. 11. CIRCULAR MAZE WITH CAMERA LUCIDA ADJUSTMENT

Maze same as in figure 10. *W*, wire screen; *M* and *M*<sub>1</sub>, reflecting mirrors; *L*, *L*<sub>1</sub>, *L*<sub>2</sub> and *L*<sub>3</sub>, electric lamps.

its way into the center of the maze by the shortest route, that is, without any errors, on three successive trials. The technic of training is described more in detail by Hubbert (*Jour. Animal Behavior* 1919, iv, 60).

*ANALYSIS OF THE DATA FURNISHED BY THE MAZE*

The maze problem enables the psychologist to study the mode of learning of a rat. In studying the effect of drugs, the maze problem can be utilized in two ways. Animals may be subjected to the influence of drug action first and then trained in the maze with the purpose of ascertaining the effect on the rate of learning. Again, animals may be first taught to solve the maze problem and then the effect of a drug is studied in reference to its influence on their behavior, memory-habit, etc. Furthermore, other data can be obtained from the maze, after administering drugs to rats, which may show the effect on neuromuscular coordination, and various somatic changes. As to exactly what the mechanism of learning the maze problem may be, the explanations given by various psychologists differ widely. Among the hypotheses which have been advanced to account for the reintegration of conduction paths in learning, there are at least three which stand out as rather opposed to one another in respect to the neural processes which they imply. (Lashley, *Psychology*, 1917, Vol. 1, p. 141.) The hypothesis suggested by Ladd and Woodworth

(Elements of Physiological Psychology, N. Y., 1911, Scribner, p. 551), assumes inhibition of successive activities as the fundamental process which results in the selection and fixation of random activities. The second hypothesis, given by Angell and others (Psychology, N. Y., Holt, 1909, p. 70) assumes nervous reinforcement as the fundamental process by which successive acts become linked together in habit-formation. The third hypothesis, that of Watson (Behavior, N. Y. Holt, 1914) depends chiefly upon the chance spreading of nervous excitation, or the simultaneous activation of two afferent pathways in such a way that the final common part of one is able to divert the discharge of the other and so bring about a permanent connection between itself and this afferent path. These hypotheses by no means exhaust the theoretical considerations of the maze problem (Dashiell, Psychobiology, 1920, ii). For the study of drug action, however, the various theoretical considerations are of secondary importance and the data obtained are of a much more definite nature, as will be seen from the following exposition.

#### DRUGS STUDIED

The substances investigated were as follows: tincture of valerian, tincture of asafetida, tincture of musk, compound tincture of lavender, extract of violets and oil of roses. In addition to these a

large number of samples of incense were studied, to be described below. In studying the effects of the above drugs, a simple procedure was adopted. A rat was placed under a large glass funnel, in the neck of the funnel a wad of raw cotton was inserted and a few drops of the aromatic drug were poured on the cotton from the inside of the funnel. The funnel was so placed as to leave an appreciable space at the bottom for the free circulation of the air. The normal running time and behavior of a rat in the maze was first noted, then the animal was placed under the funnel and the observations were repeated at the end of fifteen minutes or longer. Control experiments were made by placing rats under funnels of the same size with wads of cotton in some cases not saturated with any drugs, in other cases soaked with water, and in still other cases impregnated with small amounts of ethyl alcohol. It may be stated at once that the control experiments gave negative results, in other words the confinement of the rats under the funnels had no effect of itself on the running time or the number of errors made. A few experiments were performed in a different way. Rats were placed in metal boxes through which a forcible current of air was circulated by means of a pump. In order to study the effects of odors, the current of air was first passed through a tube containing a given drug. The results obtained by the two methods were



the same. In some of the experiments with valerian and asafetida a little of the tinctures was brushed on the noses of the animals instead of placing the rats under the funnels.

### *STUDY OF INCENSE*

The extensive employment of incense in the religious rites of the ancients and also its extensive employment in the Orient at the present time prompted an inquiry as to whether the inhalation of such fumes exerted any effect on the central nervous system. Accordingly, it was interesting to try the effects of burning different samples of incense on the behavior of rats. Two ingredients of Biblical incense, gum olibanum and gum galbanum were tested. Small quantities of each of these gums were heated in test tubes and the fumes allowed to be inhaled by the rats. Control experiments made by burning cellulose (filter paper) yielded negative results. In addition to these two samples of classical incense five specimens each of Japanese and Chinese incense preparations were studied.

### *RESULTS*

Of the odoriferous drugs examined the two which produced a distinct sedative effect on the behavior of rats were valerian and asafetida agreeing with empirical clinical observations. What was more in-



teresting to note, however, was that of the two principal constituents of Biblical incense, olibanum and galbanum, *neither one produced any depressant effect*, by the methods studied above. The lack of depression after the use of other incense was also surprising but agrees well with the statements of some orientals, that the inhalation of the fumes of certain specimens of incense is actually *stimulating* to the mental processes. It is evident that the railings of religious scoffers and agnostics, who endeavor to convey the innuendo that incense was burned in religious rites in order to stupefy the worshippers has no foundation in as far as Biblical incense is concerned. It is true that such things as opium and hashish or Indian hemp when smoked produce narcotic effects, but these drugs were certainly never used by the Hebrews. Again it is true that the ravings of the Greek oracles at Delphi were probably due to poisoning with carbonic acid gas given off in various coals, but such was not the case in the Holy Tabernacle or Holy Temple. (See Gwathmey: Anesthesia).

#### DISCUSSION

The above observations and descriptions are of considerable interest not only from the archaeological and historical points of view but also from the more purely scientific standpoint. The study of pharmacognosy, chemistry and other properties of the vari-

ous ingredients of incense is really essential to the proper identification of the same. Again the bacteriological and pharmacological studies described above throw a new light on the importance of the various constituents and of their combinations. While the findings are certainly interesting and unusual they can not be said to be altogether surprising because, if as every faithful student of the Bible believes, the Holy Writ is an inspired work—the word of God, Who is the Prime Source and Moving Force of all—it is but logically conclusive that whatever the ceremonial or purely ritual purposes of incense may be, the same must also be good and useful from every other point of view; so also from the purely scientific point of view. One could draw interesting inferences along such lines of thought in connection with Biblical incense. Thus for instance in the Ethics of the Fathers, V. 8, we read that there was never to be found a fly in the slaughter house of the Holy Temple. This is not only plausible but most probable in view of the insecticidal and bactericidal properties of various volatile oils and fumes which have been described above. Oil of Citronella and similar oils are even now extensively employed against mosquitoes, flies and other insects.

In the present work I have purposely refrained from an extensive discussion of the more purely Agadic or figurative passages in the Talmud and later Hebrew literature bearing on incense, because it was my

object to contribute constructive work on the more scientific aspect of the subject. On examining various passages referring to holy incense in different rabbinical works, however, one can not help correlating some of the statements made even in purely an allegorical or homiletical way with the experimental findings described above. For this reason it is deemed appropriate to quote in this place a number of such passages not familiar to the ordinary reader in order to make the present dissertation more complete.

A. The great importance with which incense was regarded by the Zohar can be seen from the following passage.

אי בני נשא הוו ידעין כמה עלאה איהו עובדא דקטרת  
קמי קב"ה, הוו נטלי כל מלה ומלה מניה והוו סלקי לה  
עטרא על ראשיהו ככתרא דרהבא. (שמות רי"ח ב').

"If men would know the sublime importance of the holy incense they would set a crown of gold on each of its ingredients" (Shemoth Rabba VIII, 2). Again we read

דההוא קטרת כד סליק תננא בעמודא, כהנא הוה חמי  
אתון דרזא דשמא קדישא פרחין באורא. (שם, שם).

"When the smoke of that holy incense used to go up straight into the air the priest saw the letters of the

Ineffable Name suspended in the air" (Ibid.). In another place of the Zohar we read

כל מאן דאסתכל וקרי בכל יומא עובדא דקטרת,  
ישתויב מכל מלין בישין חרשין דעלמא, ומכל פגעין  
בישין ומהרהורא בישא ומותנא; ולא יתנוק כל ההוא  
יומא. (שמות רי"ח ב').

"Whoever reads and studies daily concerning the constituents and preparation of the holy incense will be protected against all evil things and death" (Bereschith II). In another place we read that

לית לך מלה בעלמא למתבר לה לסטרא אחרא בר  
קטרת. (שמות רי"ח ב').

"There is nothing in the world more valuable for destroying or breaking evil influences than the holy incense" (Shemoth Rabba VIII, 2). And in another place we find

מאן דיימא "פטום הקטרת" בתר "תהלה לדוד", בטיל  
שותנא מביתא. (במדבר רכ"ד א').

"Whoever recites the passage concerning the preparation and compounding of holy incense will keep death away from his habitation" (Numeri XXIV).

In other passages similar references are made

to the prophylactic or protective value of incense against death and disease

סימנא דא אתמסר בידנא, די בכל אתר דקאמרי בכונה ורעותא דלבא עובדא דקטרת, דלא שלטא מותנא בהווא אתר; ולא יתוק, ולא יכלין שאר עמין לשלטא על ההוא אתר. (שם, שם).

"This sign has been delivered into our hands that in every place where incense is recited with devotion and good will no death will come nor any evil nor oppression" (Shemoth Rabba IX). A similar passage is found in Bersith II.

בעדנא דיערע מותנא בבני נשא, קיימא אתגור וכרווא אעבר על כל חילא דשמיא, דאי ייעלון בנוהי בארעא בבתי כנסיות ובבתי מדרשות ויימרון ברעות נפשא ולבא ענייני דקטרת, בוסמין דהוו להו לישראל, דיתבטל מותנא מנייהו. (בראשית קב', מהנע).

These various citations take on a new meaning in the light of the antiseptic and disinfectant properties of incense described in the above experiments.

B. One could extend the bacteriological conclusions obtained from the experiments described in this paper to a rational explanation of the checking of the plague mentioned in Numbers XVII, 13, without in the least conflicting with the Divine Providential origin of the phenomenon.

In the Midrash the following poetical passage beautifully harmonizes with the above.

קטרת זו, אמרו, של פורענות היא היא הרגה נדב ואביהו,  
היא הרגה קרח ועדתו. לסוף ידעו שהיא של ברכה ויתן  
את הקטרת ויכפר על העם. (מכילתא בשלח ס"ז, ה';  
רש"י במדבר י"ז י"ג).

"This holy incense is closely connected with Divine retribution. We find that in case of Nadab and Abihu, we see it again in the case of Korah and his band, and we find it also employed as a stay to the plague which befell the children of Israel." (Numeri XVII, 13.) Perhaps this antagonism between infection and death on the one hand and their destruction by disinfectants on the other may be the explanation of the statement in the Talmud that the angel of death gave over to Moses the secrets of the holy incense.

מלאך המות מסר למשה סוד הקטרת. (שבת פ"ט א').

In the Zohar we read that Elijah revealed the mysteries of holy incense to Rabbi Phineas

אליהו גלה סוד הקטרת לר' פנחס. (זהר בראשית ק' ב').

It may not be too far fetched to explain the statement of the Rabbis that incense symbolized an atonement for slander, on the same grounds.

קטרת מכפרת על לשון הרע. (ובחים פ"ח ב').

Incense is an atonement for evil tongue and as the wise men poetically expressed it "Let that which diffuses subtly (that is the fumes of incense) come and destroy that which subtly spreads its evil influence." (The Evil Tongue; Arachin XVI.)

The author is indebted to Rabbi Simon Neuhausen of Baltimore for calling attention to the above passages and also some of the following.

C. The psychological effects of aromatic perfumes and the fumes of holy incense studied by the author as described above throw also a wholesome light on several other passages concerning holy incense. It is very interesting to find that incense is symbolically correlated by various writers with prayer. Thus in the Psalm 141, Verse 2 we read

תכון תפלתי קטרת. (תהלים קמ"א ב').

"Let my prayer be set forth as holy incense before it." So also in the New Testament, Revelations Chapter 8, Verse 4, we read "Incense which came with the prayers of the saints." and Verse 8 "Golden jars full of odors which are the prayers of the saints." In St. Luke, Chapter 1, Verse 10, "Multitude of the people were praying without at the time of incense." According to the Shocher Tov, King David says,

אמר דוד: רבוני! כשהיה בית המקדש קיים היינו מקטירים לפניך קטרת.. עכשיו תקבל תפלתי. (שוחר טוב, מזמור קמ"א).



"Oh! Lord when the holy Temple was extant we offered incense unto Thee. Now do accept our prayers." According to Rabbi Neuhausen, the root 'atar, signifies both prayer and smoke.

Finally in the Zohar we read again

מה בין צלותא לעובדא דקטרת? צלותא אתקינו לה באתר דקרבנין דהו עבדי ישראל. וכל אינון קרבנין דהו עבדין ישראל, לא אינון חשיבין כקטרת. ותו מה בין האי להאי? אלא צלותא איהו תקונא לאתקנא מה דאצטריך; קטרת עביר יתיר מתקון.. דאעבר זוהמא ואדכי משכנא. (שמות רי"ט א').

"What is the difference between prayer and offering of incense? Prayer was instituted to take the place of sacrifice after the Temple was destroyed. Yet all the offerings that Israel thus brought were not as precious as the aroma of the incense. Prayer is a supplication for help and the fulfillment of our wants; holy incense symbolizes purging of uncleanness and spiritual purification." This passage from the Zohar evidently is intended to emphasize the subtle psychological effects of odors and perfumes on the emotions and mind.

A great deal more could be discussed along such homiletical and Agadic lines. The author, however, prefers to confine his dissertation to those phases of the subject for which he is more especially qualified and leave such deductions to others, always bearing in mind the dictum of R. Tarfon "'Tis not in-



cumbent on thee to complete the whole, yet art thou not absolved from doing what thou canst." Finally while meditating on the subject one cannot help but come to the conclusion that if every scientist or scholar, whatever be his chosen branch of learning, were to endeavor and contribute his own little bit towards the appreciation of the Holy Writ, the sum of knowledge thus obtained would lead to only one conclusion, as the philosopher Koheleth has strikingly put it: "The sum of the matter after all hath been heard is to revere the Creator and observe His commandments."

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The author is deeply grateful to all those who have made the publication of this work possible and especially for the active interest in the work shown by Drs. Harry and Julius Friedenwald, of Baltimore, Maryland.









